ADVANCED MANAGEMENT

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Comment

SOME ideas seem to gain a life of their own which adds to the momentum they acquire for reasons of timeliness and utility.

Such an idea is Donald Nelson's proposal for joint management-union war production committees.

"Business Week," "Mill and Factory," the CIO—these are among the varying groups which have pronounced with affirmative interest on their behalf.

The CIO, for example, at a recent Washington gathering offered the following declaration of intention on labor's collaboration in the war effort: [1]

> 1. Effective labor-management committees must be initiated in every war production plant. Where they are now in existence they must be revitalized and their efforts intensified for increasing and smashing all production records. The herculean task which American industry already has accomplished shall be surpassed with expanding production in every war plant throughout the nation.
>
> 2. The CIO shall initiate and carry forward production conferences in every war industry to marshal the resources and energies of all for ever-increasing production.
>
> 3. Labor must take the initiative in eliminating every possible obstacle in the way of total production—the real causes for absenteeism, such as poor housing conditions and inefficient scheduling of man power and material must be eliminated; a more effective utilization of man power must be achieved, and a more coherent and integrated scheduling of work and material must be attained.
>
> 4. There must be initiated an immediate and effective participation of labor in the War Production Board—at every level—with labor being given the highest responsibility in the formulation and execution of our policies and activities pertaining to production.

A thoughtful and experienced commentator on labor relations, Professor Sumner H. Slichter of Harvard University, has recently published such a helpful analysis of this development that we reprint his exposition in the interest of more light and more production:

In time of peace, most unions leave to management the responsibility of getting out production and keeping down costs. In time of war, managements are overwhelmed with problems which prevent their giving attention to a multitude of important details. The men at the machines and benches are able to give help. Mr. Nelson's appreciation of this led him in March to urge the establishment of labor-management committees to promote production.

By November, 1800 enterprises with approximately 3,000,000 employes had established labor-management committees. This is a passably good record, but nothing to boast about, especially since some industries which could best use help from unions, such as shipyards, have set up few committees. Unfortunately, only about 300 of the committees are really functioning. Some workers have feared that labor-management committees would simply mean speed-up. Even more important have been material shortages. Workers have not seen why they should be asked to produce more when they are being laid off every now and then because of lack of materials. In the main, however, the failure to establish more labor-management committees is attributable to employers.

Part of the explanation is the failure of managers to realize how much ability there is among the men who punch time clocks. It is true that a small minority of the working force, usually about 10 per cent, is responsible for nearly all suggestions, but this minority is important. Executives who started at the bottom forget how many present executives came from the ranks and how many future corporation presidents and plant managers are running machines today. More important is the unwillingness of many employers to see unions gain the influence and prestige which labor-management committees (especially successful ones) would give them.

Closely allied to this objection is the fear of some employers that the committees are simply an attempt by unions to run the employer's business. This last fear would be less prevalent if unions and managements alike were to distinguish sharply between making suggestions and deciding which suggestions were worth trying. It is the responsibility of management to decide what new ideas are worth a trial. But it is a mark of good management to get as many good ideas for improving methods and processes from as many sources as possible.

The range of activity of the committees has been very great. Many of them have done little more than coin slogans and supply "pep" material for plant bulletin boards. Some have ceased to meet. Others, few in number, have really come to grips with problems of safety, transportation, labor turnover, and absenteeism. A still smaller number have handled technical problems of increasing output, conserving materials (very im-

(Please turn to page 5)

[1] Quoted from New York *Herald Tribune*, February 1, 1943.

Looking Forward

By PERCY S. BROWN

President, The Society for the Advancement of Management

THE function of management has vastly changed during the past fifty years. Recently we have been surveying this change and have been calling it a "Managerial Revolution."

No revolution, seemingly, was intended. It was not that the managers, in their lust for power, conspired to wrest control of the factories from their lawful owners. We had simply come upon a time when the lawful owners could not operate their lawful "ownings" and only scientifically trained managers could.

In earlier days, the man who owned a blacksmith shop was likely to know more about it than anyone else. He was likely to be a blacksmith and to have intimate knowledge of all the tricks of the trade; and the fact that the shop was his made him more interested in its success than any hired helper would be. But when the old blacksmith shop evolved into a modern steel corporation, the whole setup changed.

The "owner" now was not one man. He was more likely to be a thousand; and relatively few if any of these thousand "owners" were likely to know anything at all about steel-making. All they knew was that they possessed some stock in this or that corporation and that the corporation operated some factories or something. They might not even know where the factories were located or what they were supposed to be turning out.

That sort of "owner," obviously, was not equipped to manage his property, and was probably not equipped even to choose a manager. So little groups of capitalists gained control of such corporations. Unfortunately, even these capitalists were not always interested in the successful operation of the industries which they controlled. Sometimes they were more interested in profits for themselves; and if it seemed more profitable to them to wreck the corporation than to run it as well as it could be run, they might sell millions of dollars of watered stock, wait for the company to collapse and then buy it back for a fraction of what they had sold it for.

To protect investors, therefore, as well as to assure public service, government inevitably had to interfere with business; and this period of more and more government interference has, curiously, coincided with the period of the managerial revolution.

Few modern capitalists would now defend those old, highjacking tactics. Most of them know, in these days, that permanent success cannot be built upon wrecking the properties under their control; and that industries, to become successful, must be scientifically managed for the performance of some real service to the public.

To be sure, they are still widely opposed to what they call government interference; and usually they oppose not only specific measures but oppose the very idea of government regulation as going contrary, somehow, to American tradition.

It is not my purpose to take sides in any of the controversial problems confronting management today. Partisanship is not a function of management. As citizens, we may debate endlessly upon the right or wrong of any proposition, and then we may decide the issue by ballot. But as managers, we do not decide by vote as to whether a particular chemical combination of process, for instance, is right or wrong. We do not even tell each other how we "feel" about it. We are not even concerned as to whether or not it is in accordance with *any* tradition. If we do not know the answer to any specific problem, it is our job to find it, regardless of how it may clash with preconceived ideas.

But I cannot help noting that we have passed through a managerial revolution. Little by little it became apparent that the owners of industry were not endowed by their ownership with any genius for operating industry. Fortunately, boards of directors were not slow to learn this; and instead of giving directions as to how their industries should be managed, they usually elected a president and left the problems of operation to him. The president may have been given orders as to the conduct of the concern; but if he was a wise president, he did not take these orders too seriously. For he knew what the capitalists really wanted. They wanted profits; and if they did not get profits, he could not excuse himself by contending that he had followed orders.

And if he was a wise president, he did not issue many orders to his subordinates. He consulted them instead. He tried to find out what they had found out. And the

subordinates, if they were wise, found out what to suggest by constant consultation with workers generally.

And because it was more profitable generally to know what to do, instead of issuing orders in accordance with anybody's theory of the rights of ownership, more and more problems came to be referred to the managers; and with managers instead of owners more and more determining the policy of their industries, management had to assume greater and greater responsibilities.

These managers might not be humanitarians, or more permeated with the milk of human kindness than were their employers. Nevertheless, in the process of discovering the laws governing industrial evolution, they learned many things which mere ownership could not teach. They learned, for instance, that discontented and embittered employes did not work as efficiently as did those who were well paid and not inhibited by grievances. Later they learned that the marvellous American system of mass production could not be kept in operation unless the masses were in possession of buying power and able therefore to consume its tremendous output.

Traditionally, it had been supposed that the product of labor had to be divided somehow between workers and employers; and that, if one group received more than its rightful share of this product, the other group would inevitably receive less. But this tradition had its origin in an economic system which had passed away. That was the system in which the worker divided his time between producing things for his employer's consumption and for his own family's consumption. He was essentially a servant and his employer a master. The modern industrial worker may be a servant too, but he is not a servant of his employer. He is a servant of the buying public. If he is a shoemaker, he doesn't divide his time between making shoes for his employer and for his own family, but gives his whole time to making shoes for whoever wants and is able to buy those shoes.

This is just one of the ways in which tradition was at war with the facts. It was not the intention of the industrial manager, perhaps, to interfere with the business policies of the company for which he worked. He may not have considered it his business whether the employers were generous or greedy in their labor relations. But it was his business to discover the natural laws governing machine production, and to obey those laws, quite as much as it was his business to keep from violating the laws of chemistry and physics. And it just happened to be a law, inherent in the nature of mass production, that the machinery could not be kept in operation unless the masses were being served, and their standard of living increased, as new discoveries and more scientific management increased the productivity of the machine.

Now that wasn't always true. *It isn't even true today.* But it was true yesterday, when the only market available to mass production industries was a public comprised largely of wage-workers; and it seems certain that it will again be true as soon as the menace of Hitlerism is destroyed. For the moment, however, we have a different kind of market. The American people, through their government, are still buying things, and they are buying at a rate never dreamed of in any previous time. But they are not things to consume. The things they are now buying are weapons with which to destroy Hitler, and food and supplies for the huge armies engaged in using those weapons. And so, while our factories are busier than they ever were before, and while we are rapidly learning better and better methods of production, our standard of living generally is going down.

As soon as the war is over, however,—and none of us knows how soon that may be—the only market large enough to keep our factories in operation will be the market of human need. A poverty-stricken, hungry, sick and suffering world will *need* everything that American industry (and American agriculture), running at top speed and under the most scientific management, can supply. And if that market is supplied, the whole world may get down to work and produce the things which Americans want, and there may be world prosperity within a magically short time.

But I am not so sure that we shall open up that market. Many of the things which some of the owners of American industry are now saying frankly alarm me, when I look at the problem from the standpoint of industrial management.

They are hinting, for instance, that we do not want any over-all planning. They are demanding not only that government interference shall cease but that we shall not engage with the United Nations in any kind of scheme to assure world peace and world prosperity. Many are clamoring that the laws we have enacted to guarantee some minimum of buying power to our own American workers, and to recognize organized labor in our economic society, be repealed, and that we go back, somehow, to what they call the American tradition.

I would not worry so much about this if all of these vocal industrialists had some plan of their own to put in place of any which has been proposed. But that is

not their idea. They are not asking for better plans but for no planning at all. They want what they call "free enterprise," and I cannot make out what they mean by it. I am sure they do not want to go back to the old days when anybody who could gain control of a railroad was free to run it or wreck it as he saw fit. I doubt that they want to go back to the days when people were free to get rich by advertising and selling supposed cures for cancer. I doubt that they want to abolish our health and sanitation departments or our educational systems, which so restrict the right of our people to decide for themselves what they shall do with their garbage, or whether or not to send their children to school.

Whatever they mean, it seems to me that they have offered a whole lot of problems for management to study. I mean that we should find out what to do, and educate our bosses if necessary, if we should discover that they are committing themselves to some course which can only lead to war or poverty and unemployment and even result in their own financial ruin.

The First World War might have been the last world war if we had only known what to do. Getting back to normalcy, however, was not the answer, even if there was a landslide vote in favor of it. And we know now that isolationism was not the answer. I do not pretend to know what the answer is. But it seems obvious that the problem is a problem of management, and that this Society for the Advancement of Management ought to be able to throw some light upon it.

I doubt if the late depression was inevitable. We had all the makings of prosperity except the know-how. We had plenty of capital, plenty of labor, plenty of natural resources, plenty of machinery and equipment and plenty of skilled technicians. But we had no plan—no scheme for assembling all these elements so that each could play its necessary part. It was not only that those in control of industry had no plan, and hated the very thought of there being any plan, but the managers, who had become highly skilled in the coordination of separate plants seemed to have no idea what to do when those plants ceased to be separate and became so interdependent that a shut-down anywhere was likely to result in a shut-down everywhere.

Are we, I wonder, going to shirk our responsibility again, in case the end of this war should bring on another industrial breakdown? Even if we knew what to do, of course, it doesn't follow that it would be done. For managers are not in complete control of industry. They are merely a factor in its control; but as the managerial revolution has proceeded, they have become a more and more important factor. And we gained this position, let me repeat, not by usurping authority, but by learning the know-how when nothing but the know-how would do.

Just now, however, when we read in the papers of "industry's" position on this or that urgent problem, do they mean what managers, acting strictly as managers, have discovered? Seemingly not. They seem to mean what the owners of industries, in their capacity as upholders of some vague traditions, think that they believe.

Free Enterprise, for instance. All of us, I think, believe in free enterprise, but there might be a great difference in the way we would define the term. It seems to me that the only freedom anything can have is freedom to obey the laws of its own nature, and that industry cannot be really free until it obeys the natural laws of industry. I am sure, however, that that is not what is meant today when the vocal part of industry talks of free enterprise in opposition to every change it is not yet ready to accept.

I propose, therefore, that our Society give some real study, as soon as programs can be arranged, to a considerable list of problems which may have seemed heretofore to be beyond the scope of industrial management. And I think that one of these studies might well be an effort to find out what free enterprise really is. Not merely what it was, when industries were small and relatively independent, but in these days when everything seems to be inseparably dependent on everything else.

I think we should also get some know-how, if possible, on this absorbing problem of social security. It is being claimed just now that social security tends to undermine individual initiative. I'd like to know: Are people likely to become dull-witted if they know where their next meal is coming from? Or is it only the kind of security which is not socially administered which has this deleterious effect upon the human character? In what way, for instance, does social insurance differ basically from, say, the idea of having a public fire department? Or would a fire department be better if it gave its service only to the homes of the better class of people?

Then there is the Wagner Act. Has it been the failure which some industrialists are now saying it has? What do managers know about how it is really working? And what can we find out?

Next, I do not see how we can avoid studying the race problem, not from the standpoint of traditions and

prejudices, but from the standpoint of ascertainable facts. What do we know, for instance, about Negroes in industry—not about our experience with a few Negroes, for that might not be more significant than our experience with a few men who happened to be tall or short or redheaded—but whether, from the standpoint of management, there is any sense in drawing a color line? The whole world is in total war today because of a certain tradition—the tradition that there is and should be a Master Race. Haven't we something to learn, and something to teach, concerning that tradition?

And how about the alien in industry? I think we could do well to devote some study to that. I would like to know, for one thing, just who is alien in a world which has become as interdependent as the one we are living in now. It seems likely that immigration laws will almost necessarily come in for much restudy in the near future, because of facts which were not facts when our present laws were enacted. I do not know what we should do. But I do know that the whole world has changed during the past few years; and that not only China and Russia are much nearer to us than they used to be, but that the people of China and the people of Russia also are much nearer.

And how about women in industry? Millions of them are now employed in work which American women never did before. For all I know, they may decide to remain in industry; and that seems to present a problem which we just cannot afford to ignore.

Recently we heard the interesting news that the Supreme Court had unanimously upheld the conviction of the American Medical Association for its interference with certain "group health" projects. That should be interesting, not merely to physicians but to industrial managers; for all of us are agreed that we want the highest possible standards of health in our organizations. How can we get it? Much of the argument of the medical societies does not seem to bear directly on that question but is seemingly more concerned with upholding certain traditions. But are we excited about upholding medical traditions? We want the facts. Can't we have qualified doctors join with us in discussing group medicine, pro and con? And isn't it a question upon which we should gather all the data we can?

In all these discussions, in fact, I think we should invite the best possible representatives of conflicting viewpoints to unite with us, and not merely for debate but for all the information they are able to provide. I am not thinking of these studies in debating society terms. When matters of such world importance are at stake, we are not anxious to be entertained. These chapter meetings, it seems to me, can be genuine fact-finding seminars. And while many other subjects will immediately suggest themselves to the membership of the various chapters, I have listed these, not in spite of, but because of their being somewhat outside our traditional lines of research. We have already arrived in a new world. It is not like the world in which we first learned management. We must learn new truths now, and accept new responsibilities.

Comment

(Continued from page 1)

portant in these days), and reducing spoilage. All too seldom does one find a man near the very top of management, and another at the head of the union, fitted and ready to take an active interest in the committees and stimulate them to produce results. Committees reflect the interest of the executive heads of management and unions and they are not productive if their existence is merely tolerated.

As shortages of materials and manpower become more acute, the need for help from unions in conserving materials and reducing spoilage will become more urgent. By suggesting more and better inspection, a union was able to cut spoilage on gun barrels by 95 per cent. More output from existing plants and equipment would reduce shortages because it would permit raw materials to be used for planes, tanks, and vessels instead of new plants. In most plants in peacetime, workmen impose informal limits on their output. They may do it because they fear that more production will mean layoffs or bring cuts in piece rates, or because the removal of restrictions might lead to overwork. Mr. Nelson probably had the lifting of these informal limits in mind when he said: "Let no man fear that by putting more steam into his effort he will soon run out of work." Labor-management committees are well fitted to handle informal restrictions on output by reviewing the feeds and speeds used by the men on various machines and obtaining guarantees that more output will not cause reductions in piece rates.[2] ORDWAY TEAD.

[2] Reprinted from *Atlantic Monthly*, January, 1943, with the permission of the author and the publisher.

Rhythm in Time and Motion Study

By CHARLES BABBITTS

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Motion Study Without Rhythm

Attitude toward Rhythm

CONFUSION exists in the field of motion study because of a one-sided view on the subject of motion economy. The concept of the "shortest and quickest" method has become a fetish which blinds many to more fundamental aspects of human movement. There exists generally an ambiguous attitude toward rhythm and a tendency to underestimate its role.

An examination of the literature of time and motion study reveals that the three words "rhythm," "ballistics" and "momentum," if found at all, are usually relegated to the end of a chapter on motion economy. And in this inglorious position they are soon disposed of in a hazy manner. The *Cost and Production Handbook* which publishes only the essentials from each branch of industry, accurately reflects this condition by failing even to mention these words in connection with the subject.

Scope

This article attempts to underline those writings already in existence which seem to recognize the basic importance of rhythm, and to introduce additional material from other fields as well as concrete suggestions for the application of rhythm.

Much of the new data stems from fields foreign to motion study proper; namely, those of violin pedagogy and the process of developing and teaching an original system of dance notation for the quick and accurate recording of body movements.

In studying the violin I was privileged to learn the Russian, German and Franco-Belgian schools of bowing from their foremost pedagogical exponents. In the manipulation of the hands in violin playing are found the most complex skilled movements ever developed. Information gleaned in mastering these difficulties can be applied with profit to the study of all activities of the hands.

In the work on dance notation, it was necessary to analyze movement from the subjective and objective point of view (dancer and spectator), and in the search for a middle ground in which a readable system could be located, the nature of the body in motion had to be studied in a manner quite different from ordinary motion study.

The scope of this work does not permit the discussion of much industrial details—for this a larger work is planned. But the field of training will be treated in some detail.

Two Paradoxes of Time and Motion Study

Science versus Business

The position of time and motion study in industry gives rise to an inevitable conflict between the forces of economy and science. Economy is expressed by the usually shortsighted demand for immediate savings, suddenly increased output, and so on. The scientific, on the other hand, obtains results which are not always obvious or spectacular because they are achieved more gradually bringing benefits of a more permanent nature. In this category are such changes as the introduction of more frequent rest periods, training in rhythmic work patterns which do more to decrease fatigue than to increase output immediately, and various types of research.

In this conflict the time study man usually finds it expedient to view motion through the distorted glasses of time rather than as an aspect of physiology and rhythm, subject to laws of its own. It is thus inevitable that shortcuts should be found which are not always scientific.

This is the first paradox: a scientific profession which depends upon unscientific means for survival.

Speed versus Rhythm

The chief weapon of time and motion study is its various instruments of measurement usually headed by the stop watch. Accustomed to depend upon these, it has come to look upon non-measurable things like ease, beauty and rhythm of movement as ornamental attributes.

Yet these attributes and not the time element are the

reason for the highest efficiency and every worker, properly trained, may learn to acquire them.

Most time and motion study men will admit that their best ideas come not while searching a simo-chart for economy but while closing their eyes, moving their hands and visualizing the total rhythm of an operation.

The time measurement methods are needed to help find wasted motion and for accurate before and after comparison, but have little to do with the rhythmic construction of a movement cycle. To do this on the basis of time requirements is to emulate the false economy of a tailor who makes a size 32 suit for a size 56 man merely to save cloth and measuring tape. As the suit should fit the man so should the movement fit the human body and not the clock.

Thus we come to the second paradox of time and motion study: while its primary purpose is to discover the shortest and quickest way of performing an operation, the shortest and quickest movements of the operator are usually the least conducive to this end.

Not to appreciate these paradoxes leads to error as we shall see.

Rhythmic Training

The paradoxes of time and motion study have their reflection in industrial training; before the time and motion study man can train the worker in rhythmic movement he must first train himself.

Mathematics cannot be learned by studying the laws alone, one must also do examples; so in motion study, one can only arrive at an understanding of the nature of rhythmic movement by performing actual examples with one's own body. One should try to perfect, for example, some movement in sport, industry or the arts, perform it in various ways, test the relationship between the appearance and feeling of the movement. One can thus learn among other things to differentiate between true and forced ballistic movement in others.

Rhythmic motion cannot be learned it must be *done*.

A fitting conclusion to this section are the following rarely quoted principles of Eric Farmer (British writer on time and motion study):[1]

> 1. All time and motion study must be undertaken solely in the interests of lessened fatigue and never in the interests of increased production. When a proper system is carried out, increased production will probably result, and in all cases which have come under the writer's notice has actually taken place; but if increased production is made the object of the experiment the true issue becomes confused, and what purports to be a scientific investigation degenerates into a process of speeding up.
>
> 2. The underlying principle of motion study is rhythm and not speed. We must look upon the best set of movements as the easiest set and not the quickest set.
>
> 3. The proper use of time study is for the analysis of an operation in order to suggest lines of improvement, or to determine the relation between processes, rather than for standardization. The setting of a standard tends to introduce an interfering element in the worker's mind. All the effort of the investigation should be concentrated on lessening fatigue and increasing the ease with which the operation can be performed; *other things being equal* the operatives will set their own standard which will be satisfactory to all concerned. (Italics mine.)
>
> 4. Time and motion study is only part of a whole region of study affecting the human element in industry, and can only be carried out in conjunction with the study of other equally fundamental problems.

[1] See Viteles, Morris S., *Industrial Psychology*, W. W. Norton and Company, New York, 1932, pages 436-7.

The Nature of Rhythm

Definitions

Rhythm

> The sense of rhythm is an instinctive disposition to group recurrent sense impressions vividly and with precision by time or intensity or both, in such a way as to derive pleasure and efficiency through the grouping.
>
> Rhythm is thus not an attribute of sensation like time and intensity. It is a complex process and involves literally the whole organism in the form of responsiveness to measured intervals of time or tone. Rhythm as a whole presents two fundamental aspects, the perception of rhythm and rhythmic action. (C. E. Seashore, American professor of music psychology; inventor of devices and methods for accurately measuring physical dexterity and musical talent.)[2]

Ballistics

Ballistics is concerned with the hurling and motion of projectiles. It has come to be associated with human movement because fast swinging motion of parts of the body are, to a degree, hurled. From a rhythmic point of view there are more subjective ties. The movements of *throwing* have long been associated with rhythmic control; and one has the feeling of *throwing* oneself into a rhythmic movement.

Momentum

In human movement momentum is a quantity of movement judged by the impetus and the amount of time required to bring it to rest.

[2] Seashore, C. E., *Psychology of Musical Talent*, Silver Burdett and Company, New York, page 113.

Sphere of Influence

Rhythm

All natural phenomena from the movements of the stars to the beating of the heart obey the laws of rhythm, expressed through motion and sound. When a series of repetitive motions appears to lack rhythm, it is in reality being performed in bad rhythm.

All work performed by the human body results from the activity of the muscles; these perform at their best when moving as a rhythmic whole; rhythm, therefore, is the basis of human work in its most efficient state.

The manner in which rhythm dominates the nervous and physical organism can be seen in the following examples chosen at random:

1. Unrhythmic living habits like irregular hours for sleeping and eating can be the cause of ill-health.

2. The recuperative powers of rhythm are demonstrated by the phenomenon of the dog-tired worker who spends the evening in hours of dancing, or weary soldiers who are electrified by the sound of a brass band, or even a single drum.

3. Rhythm has a fundamental power on the human mind. Hearing a prolonged series of identical beats, the average person will begin to hear imaginary accents which will divide the beats into mentally formed groups of equal value. The need for subdivisions or accents is demonstrated in tongue twister experiments. By introducing proper accents the most complex twister can be spoken quickly by the same individual who has difficulty pronouncing it with even emphasis. Moving wheels on a railroad track will not only instigate mental accents but also words and even melodies. Protagonists of the "no accent" principle of movement, forget that it is the mental accent which makes their method possible.

4. Rhythm and motion are difficult to separate: teachers of eurythmics [3] find that when a pupil is directed to interrupt a rhythmic walk after several steps and stand still for a number of beats before continuing the walk, he will move some part of his body to help the mind keep time. Warned to remain motionless during the interruption, students resort to tiny movements of the ear or the tongue to help maintain the beat.

Ballistics and Momentum

The ballistic as opposed to the fixation movement is one in which a movement of the body swings freely without interference from other muscles; when opposing muscle groups contract, a controlled (fixation) movement results. Movements of holding or grasping are examples of this type.

The ballistic movement being tied to a rigid (fixation) base can be compared to a flag waving in still air. To be sure, the flagpole does not motivate the flag as the body motivates the arm, but the function of inertia is similar. When the pole is moved to the right the flag waves to the left, as though it were left behind and then pulled along. When the direction of the pole is reversed the flag stops for a moment and then is again pulled waving in the opposite direction from the movement of the pole. If a circular path is followed, the flag maintains an unchanged relationship to the pole.

Hartson [4] says that the momentum of a ballistic movement can be terminated in one of three ways:

1. By the contraction of an opposing muscle.
2. By an obstacle.
3. Through dissipation (like a golf swing).

Except in cases of necessary termination by obstacle, terminations of ballistic movements should as a rule be avoided since they interfere with rhythmic movement. The best way to terminate this type of movement is a suggested fourth way: *to terminate a movement by continuing unchecked into the next movement.*

Experiment in Ballistics

It is recommended that the time and motion study man, now resolve to study movement by doing as well as reading, try the following experiment upon himself, using the various parts of his own body to illustrate the flag to flagpole relationship; waving arm from shoulder, hand from wrist, forearm from upper arm, etc. If performed with the proper care and freedom the following conclusions may be derived from this experiment:

1. In every combination of movements the power travels from the trunk to the extremities (as from shoulder to hand instead of vice versa).

2. By imitating the turning movement of the flag without shock of sudden change, the ballistic movements are facilitated.

3. The most natural ballistic movement with its little rounded additional movements resembles more a dance than it does anything else.

If he further complicate this experiment by the addition of a fixation at the end of the hand—holding, throwing or pushing an object—he may make some dis-

[3] See Pennington, Jo, *The Importance of Being Rhythmic*, G. P. Putnam's Sons, New York, 1925.

[4] Hartson, L. D., "Analysis of Skilled Movements," *The Personnel Journal*, June, 1932, Volume II, No. 1.

coveries on the relation between ballistics and fixation movements, which will upset his previous notions. These will be discussed later.

The feeling of freedom and relaxation in the muscles following this experiment may incline one to take issue with W. G. Holmes [5] when he says: that an "arm movement of 4 inches does not have the free curved ballistic sweeps which can be woven into an 18 inch movement."

Repeating the experiment of moving the arm back and forth with a relaxed turning movement of the wrist and elbow joints co-ordinated on the flag principle will show that movements which follow a natural curved path at an unforced rate of speed are all equally easy. It is only when movements are artificially restricted to separate parts of the body that long ones seem to "sweep" more easily than short ones.

Conclusion

With stop watch, micro-motion study, etc., we enlarge and analyze motion at close range. But these methods are secondary to that one of stepping back to get a general rhythmic view of the movement pattern.

Stated in the order of their importance, as popularly conceived we have *time, motion* and *rhythm*. To get the true picture of their relationship we have only to turn them upside down. *First comes rhythm,* the basic idea; *then motion* which activates the idea, and *lastly time,* which measures, tests and indicates the course of further study.

Rhythm and Motion

Studies in Hand Motions

Among Barnes' authoritative "principles of motion economy" we find the following well-known rule:

"4. Hand motions should be confined to the lowest classification with which it is possible to perform the work satisfactorily." [6]

Following this there is the description of a motion which obviously belongs in the first classification; namely, the finger movement of a telegraph operator. But this movement, says the writer, should be assisted by movements of the wrist and forearm which are in the second and third classification. The reason for this contradiction is that the continued use of a solitary muscle unaided by its neighbors soon leads to exhaustion.

Since a movement in the first classification does not exist in reality, and since other movements involve all classifications, the statement of this principle is altogether unnecessary. And since furthermore, the original purpose of this principle was only to prevent abnormally long reaches of the arms and bendings of the body, I suggest that it be restated as follows:

Arm movements should be performed as close to the body as is possible without complicating the rhythm of the operation.

Using Momentum

Because momentum is viewed as a separate entity which can be added or subtracted from movement, the next stated principle of motion economy offers little help to the student. The statement that "momentum of an object is its mass multiplied by its velocity" means little when unaccompanied by a usable suggestion.

In the following example of hammering, we see that momentum is really a factor in rhythmic movement, and unimportant by itself. The example shows how one can increase the mass which is to be multiplied by velocity, by a natural undulating movement. This movement can be taught to a worker after the time and motion study man has mastered its principles himself. (Note: It is an open secret that two time study men will rarely level an operator at the same rate. Comparative leveling experiments with large groups of time study men have resulted in discrepancies so wide as to be scandalous. If every time study man would proceed by first performing the job he observes, at least in pantomime, he could soon improve the accuracy of his leveling through learning to use his own carefully leveled dexterity as an index to the difficulty of the job and the skill of the operator, and learning the nature of work through actual experience and study.)

The hammering in this case takes place under the following conditions:

1. Carpenter's claw hammer with 12 inch handle and 16 ounce head is used.
2. Handle gripped about nine inches from head.
3. At moment of impact
   a. handle is at right angles to vertical nail.
   b. upper arm is close to side of body.
   c. forearm is at right angles to upper arm.

This blow can be struck in several ways according to the different classifications of hand motions [7] which we will attempt to analyze:

"1. Finger motions."

Impossible to manipulate the hammer usefully in this classification, while fatigue is almost instantaneous.

[5] Holmes, W. G., *Applied Time and Motion Study,* The Ronald Press Company, New York, 1938, page 263.

[6] Barnes, Ralph M., *Motion and Time Study,* (Second Edition), John Wiley & Sons, Inc., New York, 1940, page 161, etc.

[7] Barnes, *ibid.*

"2. Motions involving fingers and wrists."

This is useful for delicate work but not for strong strokes.

"3. Motions involving fingers, wrist and forearm."

By bending at the elbow as much as possible and holding wrist and fingers fairly rigid, a restricted amount of force can be generated. A literal interpretation of the "lowest classification" principle could lead one to call this the ideal method for hammering since it accomplishes the task with the least possible number of movements.

"4. Motions involving fingers, wrist, forearm and upper arm."

A more liberal interpretation of the "lowest classification" principle might permit the participation of the upper arm in hammering: "Momentum employed to assist worker wherever possible." By suggesting that momentum be used as an assistant instead of as a motivator, the author implies that the forearm *raises* the upper arm during the upward stroke instead of being raised by it. This movement is stronger than that in example 3, but is lacking in vitality and falls short of maximum power.

"5. Motions involving fingers, wrist, forearm, upper arm and shoulder. This class necessitates disturbance of the posture."

This last sentence reveals a basic confusion in the mind of the author regarding two different categories of motion: movements of the body in relation to the work place, and movements of different parts of the body in relation to each other. True, *disturbance* of the body to reach a poorly located tool is unnecessary; but *using* the body to facilitate the hammering movements of the arm is a natural process, the absence of which can cause tension and fatigue. The motivating functions of the body are viewed as a "disturbance"—a necessary evil.

In hammering, the ideal powerful stroke involving a minimum of energy expenditure and a maximum of force can only be obtained through the skillful exploitation of the ballistic possibilities of the arm in relation to the body. The following is a breakdown of a typical movement of this kind. This description, occupying some lines of print is in actuality only a detailed account of a quick undulating movement lasting only a second, and should be visualized as such.

1. An impulse from powerful muscles in the trunk raises the shoulder slightly.

2. As a result of this movement, the upper arm is almost simultaneously raised, the elbow moving upward and outward. The forearm, wrist and fingers, being relaxed, remain behind, the hammer head resting on the nail at a slightly raised angle.

3. The upper arm reaches the height of the stroke, elbow slightly above shoulder. The hammer has just been raised from its starting position.

4. An impulse from the body snaps the shoulder downward, starting the downward stroke while the hand and wrist are still moving upward. The elbow is bent at right angles.

5. When the upper arm is about half way down, the hand reaches the height of the upward stroke, about shoulder level. The wrist is still relaxed.

6. Both the hand and upper arm now race downward for the blow. Although the hand is starting this stroke slightly later than the upper arm, it can easily rejoin it since it is propelled not only by the unbending of the elbow, but by the multiplied centrifugal force of the upper arm's motion. The blow is thus delivered with a rigid wrist at the moment of greatest speed. The power was derived from the accumulated strength of the upward stroke, skillfully employed through the use of the negative factors of momentum: relaxed muscles and nonresistance to gravity.

In this example we can see how foreign the principles of the "lowest classification" are to the natural dynamic relationships of the body.

Fixation and Ballistics Relationship

No writer has, to my knowledge, come out in opposition to the ballistic principles of motion in work. Yet despite this unanimity almost no reports are forthcoming of successful substitution of ballistic for non-ballistic movements through training in industry. The reason for this is that there exists no method for the practical teaching of rhythmic movement.

Merely to urge the worker to relax and swing his arms freely is not sufficient to bring about the desired change. The peculiar difficulty of this problem lies not in its complexity but in its subtlety. Whereas almost every worker can swing his arms freely with a natural ballistic motion, a good portion of this freedom is lost as soon as a fixation is added; i.e., something is put in his hand. The fixations of work always interfere with the natural ballistic pattern.

The reader can verify this by performing the following experiment:

Let him first fan his face with the open palm of his hand swinging his wrist and forearm freely with a ballistic movement. Let him then add a fixation to this

movement by fanning himself with a sheet of paper. The original relaxed motion will disappear and a comparatively stiff one will take its place.

What is the reason for this "natural" awkwardness of fixation movements?

The explanation can be found in an anomolous physiological relationship between the nerves and muscles of the arms. The muscles and joints of the arm are constructed on a generally diminishing plan. The shoulder muscles are the largest; they move the upper arm which is weaker, and in turn moves the forearm which is still weaker, and so on to the finger tips. The nervous system of the arm is also constructed on a generally diminishing plan. In this case, however, the order is reversed. The nerve endings are most numerous at the finger tips and hand, diminishing in number as they near the shoulder. This contradiction: the least nerves in the largest muscles, the most in the smallest, creates under certain conditions a physical distortion which is at the root of the trouble.

We may at this point attempt an absurd variation on the flagpole experiment; namely, to wave the flag while holding it only by the cloth farthest from the pole. The reason for the awkwardness of this task is that impulses of movement are better conducted from the larger stronger part to the smaller, weaker part and not vice versa.

The physical diminishing construction of the arm permits motion impulses to travel naturally from the trunk through the larger muscles to the extremities. The contradictory nervous construction of the arm introduces the interfering element. One may ask why, in the fan experiment, the interference was not present until the fixation was added.

The reason is that when the hand grasps the fan, the brain impulses travel "directly" to the hand and fingers along a line of communication which is naturally more powerful than that of the larger muscles. By thus "skipping" over the intervening muscles their activity is overlooked and an incorrect message is received, one which ignores the activity of the *causal* muscles and concentrates only on moving the hand as an autonomous unit. True, the forearm and even the upper arm may be moved along but they are no longer in their natural role of prime movers. The nerve impulse is not a true ballistic one and they move now very much like the flagpole which was waved by the flag.

Training in golf or tennis, for example, consists in teaching the nerves not to "jump" from the brain to the fingers which hold the club or racket, but to activate the powerful muscles between the trunk and the finger fixation. Whoever has tried to master these sports knows that not the grip but the body and arm control present the greatest problems. Our nervous system does these unnatural movements so naturally that we must train in order to acquire the natural ones artificially.

Fatigue and inaccuracy are the price that the worker pays for non-ballistic motions. This takes place in the following way:

The chief cause of continuous inaccuracy of movement is being off balance; i.e., attacking the task from a disadvantageous or unexpected position. In using the larger muscles this is avoided because the fixation is employed chiefly as a fixation and not for transportation and primary location. The large muscles carry the fixation to a point of approximate accuracy and the fixation is sufficiently free to perform the slight adjustment needed for perfect accuracy. By adding movement to the larger muscles one subtracts from the smaller fixation muscles which are thereby enabled to relax and function freely.

The same lack of large muscle co-operation which causes inaccuracy causes fatigue through overwork and strain of the fixation muscles. In the absence of adequate co-operation from the large arm muscles the angle at which the fixation works radically changes with every change of position. In compensating for these changes the wrist and hand must adjust themselves violently, far out of proportion to their natural limits of movement.

Economy of Ballistic Motions

One reason for the present neglect of rhythmic movement is the belief that it may be uneconomical because of the additional motions involved. In the illustrated example following we see, however, that the participation of the upper arm in Figure 2 actually causes the hand to travel a shorter distance than it does in the non-ballistic Figure 1.

Another important advantage to be gained from this movement is the favorable position of the hand at the end of the movement in Figure 2. Here the hand is in a natural relationship to the body, pointing almost directly forward, whereas in Figure 1, it is at an acute angle, off balance and uncomfortable.

The Normal Working Area

Figure 1a shows the standard "working area" [8] chart with the maximum and minimum areas shown for one

[8] Barnes, *ibid.*, page 174, etc.

hand only. Anyone who attempts to use this as a practical guide will discover among other things that it is impossible to place the hand at the point marked *x* without violently distorting the arm as shown by the darkened area. Yet this point is well within the "normal" working area. Figure 2a shows a more normal working area for the right hand than is afforded by the standard chart. It is based on a rhythmic rather than a mechanical conception of motion. This somewhat elliptical working area is also implied in the movement of Figure 2.

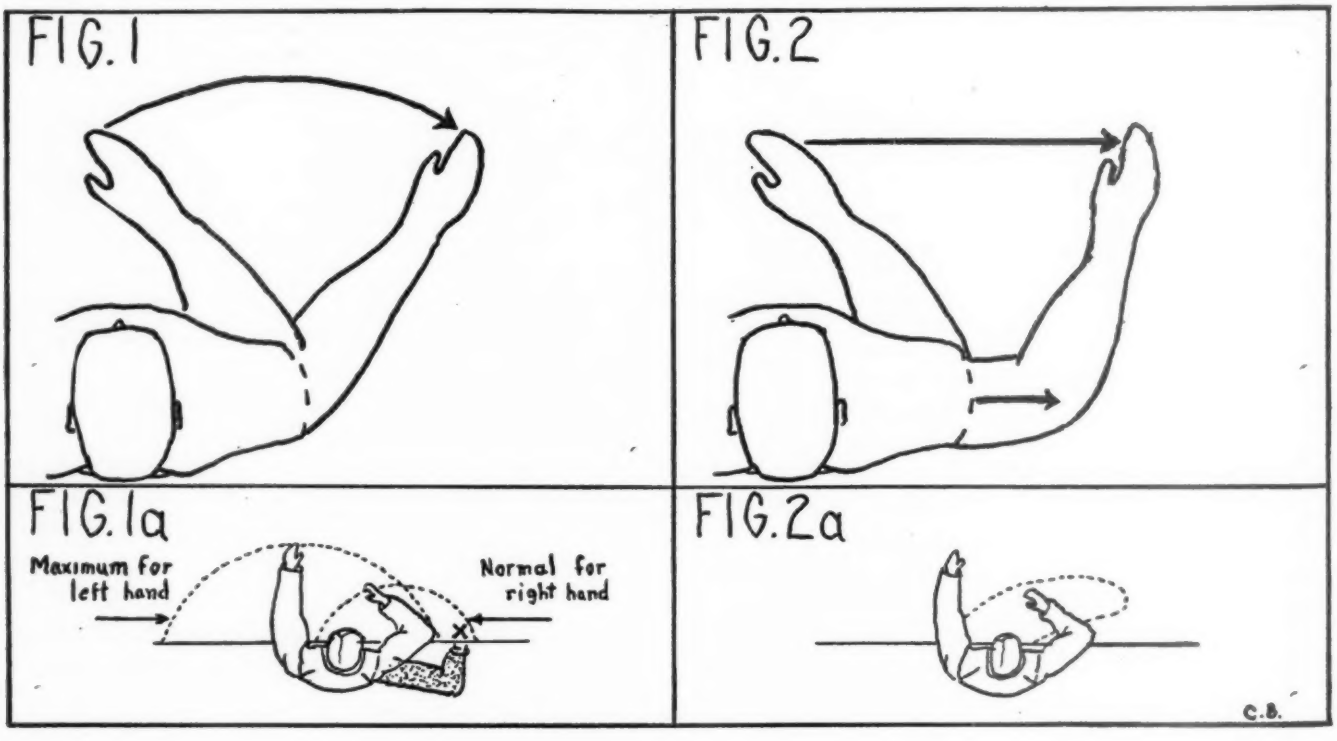
Economy Through the Addition of a Therblig

Shortest Operation	*Rhythmic Operation*
and . . reach for washer	and . . reach for washer
1. . . . select and grasp washer	1. . . . select and grasp washer
and . . slide w. to fixture	and . . slide w. to fixture
2. . . . position w. in fixture	2. . . . position w. in fixture
and . . release, reach for bolt	and . . release, reach for bolt
3. . . . grasp bolt	3. . . . grasp bolt
and . . carry bolt to fixture	and . . carry bolt to fixture
4. . . . position bolt	4. . . . position bolt
and . . insert bolt	and . . rhythmic pause
5. . . . withdraw assembly	5. . . . insert bolt
and . . release assembly	and . . withdraw assembly
6. . . . reach for washer	*6. . . . release assembly*
	and . . reach for washer

Analysis

1. The basic rhythm of this operation is a preparatory "and" count on the transport therblig and a numbered count on the accented or active therblig.

2. On the 4th count in both operations the bolt is positioned and ready to be inserted. In the Shortest Operation, no transport being required between "position" and "insert bolt," the "and" count is changed from



a transport to an accented therblig. In the Rhythmic Operation the "and" which follows the 4th beat is used as a rhythmic pause so that the bolt may be inserted on the accented 5th beat.

3. The "rhythmic pause" enables the operator to begin the second cycle on an "and" beat, exactly as he began the first. In the Shortest Operation the second cycle begins on the accented 6th beat, thus reversing the rhythmic relation of therbligs.

4. In eliminating the fatiguing nervous readjustment required by the constant reversal of therbligs, the Rhythmic Operation makes up many times for the small amount of time lost during the "rhythmic pause."

5. The "rhythmic pause" consists of a short ballistic wave of the hand in imitation of a transport motion, so that the continuity of movement is not broken.

6. The above can be called a rhythmic simo-chart. It can be used to supplement the ordinary one from which it differs in that it can be of some value to the operator. The timing of the ordinary chart is approximately rhythmic, whereas the rhythmic one by adding several thousandths of a minute here and there is altogether so. The slight loss in time which this entails is equalized by slight gains which rhythm makes possible. The gains in consistency and ease of performance are immeasurable.

Training

Rhythmic Education

The individual's rhythmic education begins in earliest childhood. Children who have had a planned education in this field according to the principles of Dalcroze[9] have developed into remarkable physical adulthood. Their muscular co-ordination, musical facility and grace have vindicated the founder of the school Eurythmics.

In contrast to this are some of the present methods which separate motion from music. The gymnasium student is forced to move in jerky angular patterns which have no rhythmic significance and are designed wholly for muscle enlargement. It is therefore doubly necessary that the motion study man, himself a product of this school learn how to teach the worker, another product of this school, the principles of rhythmic motion.

Industrial Education

With the growth of mass production, complicated trades were broken up into comparatively simple parts. Since these could be learned in a short time the long apprenticeship for the training of journeymen was generally abandoned and a haphazard copy method, little better than no training at all, was substituted.

As a reaction to this state of affairs the Gilbreths developed the "one best way" principle which has had a wholesome effect and some success in dislodging the catch-as-catch-can system. (Except for its name, the "one best way" principle is fundamentally sound, since a time and motion studied method is preferable to the chaotic situation described above. "The simplified method" is a better name. It is undeniable that after being taught the standard method, each worker likes to find his own "one best way." This does not mean that the "one best way" is wrong, or that the teacher should not insist upon it. It means only that each person is entitled to make his own *variations* to suit the structure and rhythm of his own body. Rhythmic training alone recognizes this, as we shall see in the following section, and encourages the worker to find his variations from the start and not after painful experience and resistance.) However, little advance into the field of rhythmic education followed, and as far as details of work movement are concerned, the worker still shifts for himself.

Of the various methods of industrial training today none makes a conscious effort to teach rhythmic operation. The chief question around which discussion revolves is that of "whole or part" training.

"Whole training" implies a teaching-by-doing method, while by "part training" is meant a slower system in which first the easier and then the more difficult parts are mastered. In discussing this question, Viteles correctly points out that neither of these methods is adequate in itself and that a task may be split up into "natural subdivisions" for training. This is where the problem must be attacked, but here also his chapter ends.

In the following comparison of present and proposed methods of training the operation selected is one so short and simple that both the whole and part method would be almost identical in their approach.

[9] Emile Jaques-Dalcroze, Swiss music teacher and composer, ". . . as he laid special stress on rhythm he insisted on all his pupils beating time with their hands, and this led him step by step to devise series of motions affecting the entire body." Together with the psychologist Claparide he worked out a terminology and system which he called Eurythmics. Established his own school in 1910 and has since had a profound influence in all spheres of advanced education, ballet, music and dramatics. (Quotation from Baker's Biographical History of Music and Musicians, G. Schirmer, Inc., New York, 1900.)

Present Superficial Analysis and Job Instruction	*Scientific Analysis and Muscular Training Through Rhythmic Patterns*
1. Mental Understanding Logical divisions of operation sequence.	1. Physical-Mental Understanding Logical divisions of operation and muscular sequences
2. Transfer of Knowledge from Mind to Muscle Actual physical performance of operation at working speed	2. Transfer of Physical Understanding to Muscle Establishment of rhythmic patterns through muscle-nerve preparatory training
EXAMPLE	
1. Carry nuts and bolts from bin to jig in prescribed order, using both hands simultaneously in symmetrical motions.	1. Carry nuts and bolts from bin to jig in prescribed order, using both hands simultaneously in symmetrical motions. There is an opening and closing movement of the arms with a light fixation (grasp) on each closing and the final opening (dispose).
2. Repeat operation at working speed until skill is attained.	2. Before performing operation do preparatory exercises to train body in rhythmic work pattern which will contain most natural movement sequence (see general movement training instructions).
N.B. Since a slow movement pattern is different from the fast pattern of the skilled worker, the trainee is encouraged to move quickly at once so that the skilled pattern will be followed from the beginning regardless of spoiled work. In the difficult process of absorbing the *whole* operation, the trainee cannot concentrate upon the actual movements of the work. In his haste, the trainee can only seize upon the most instinctive makeshift movements and permanent bad habits are acquired.	N.B. Since the slow movement pattern is different from the fast pattern of the skilled worker, the trainee is not permitted to perform any pattern not related to the skilled one. However, he is not exposed to the dangers of moving quickly from the beginning because the skilled, ballistic pattern can be taught slowly. This method recognizes the fact that the "one best way" can be well or badly done, according to the amount of unwarranted muscular tension present. The instructions given in column one, if applied to tennis, would consist of the admonition to grasp the racket in one hand and strike the ball with the strings. Since both the champion and the untrained amateur do precisely that there is no apparent explanation for the difference between them according to the present method of instruction.

Teaching the Rhythmic Operation

The essence of easy and efficient work cycles is the absence of mental deliberation; all is done automatically. In breaking up the operation for teaching, divisions which stem from mental comprehension must not be used. To find the rhythmic, automatic elements of the operation one must often ignore mechanically correct sequences and connect, what may from an actual process point of view, be disconnected elements. Thus by recognizing the primary importance of the physical logic of the operation, one finds the way to learn the best physical method of its execution.

Practice based upon a mental grasp of the operation is no guarantee of perfection. Unusual physical dexterity does not go hand in hand with unusual intellect. The body is trained not through mental but physical understanding. The following incident will illustrate this point:

I once spent several weeks in an unsuccessful effort to teach a student the correct execution of the jumping bow on the violin. As a last resort I abandoned the demonstration and logical explanation method and reverted to an approach of a purely physical hypnotic nature. "Do not try to make the bow jump," I said, "just imagine while playing that you are whittling the string with the bow hairs." The result was immediate success without the necessity for any further explanation. The student's muscles "knew" how to solve a problem which his brain could not and need not understand. This is what is meant by "physical-mental" understanding in the preceding comparative chart of old and new methods.

General Movement Training Instructions

Breakdown of Operation for Teaching

The teacher first studies the operation by actual doing and also in pantomime in order to find the physical outline of its rhythmic pattern. Having established the outline of movements he is ready to demonstrate to the worker, while explaining its purpose and general procedure. The trainee is then permitted to perform it, imitating the demonstrator as best he can, while his most obvious mistakes are corrected. (At this point most modern training ends.) This done, the operation is now taught in the following sequence of elements:

1. General rhythmic pattern

a. This is found by the trainee in the same manner as it was found by the teacher; namely, by performing the operation in pantomime, without tools, machine or any other object touching the hand. Moving through the process with exaggerated ballistic relaxation the natural rhythm of the operation begins to take shape. Aesthetically speaking, this movement when performed in a particular style is termed an abstraction of the actual operation.

b. Since no parts can be spoiled, there is no limit to the freedom or speed that can be gradually developed at this early stage. The trainee is encouraged to move with the greatest freedom and to co-ordinate every part of his body from head to toe, using every movement classification. There exists no operation, no matter how small, which does not have its sympathetic complementary motions in every part of the body, no matter how remote. Even though all of these sympathetic motions will not be used in actual production, they are discovered and performed so that the true rhythm of the operation can be found through exaggeration. Muscles which may be tense during the actual operation are thus loosened in advance through participation.

2. Rhythmic count

The trainee is taught an audible rhythmic means of counting while moving through the pantomime. A natural relation between the numbers and the motions is found, and the trainee consulted as to the count most pleasant for him.

3. Difficult elements

If certain parts of the operation present special difficulties they are practiced slowly and carefully, ignoring the rhythm and speed of the whole operation until they have been mastered.

4. Connecting the difficult elements

a. The separately practiced details must be tied into the whole pattern.

b. This is done not by practicing the whole but by practicing the points at which the connection of the whole with the part occurs.

c. Each of the difficult operations is practiced at working speed in conjunction with the movements immediately preceding and following it. The dovetailing of parts is most economically accomplished thus. The following musical quotation is an example of how this is done.

d. The brackets ignore musical or logical mental values, and are concerned only with the requirements of the body. The notes in bracket 1. are the difficult part which was first practiced in detail (see section 3). They are integrated into the whole by practicing the notes in bracket 2. To try to learn the part in bracket 1 by practicing the whole line would be a waste of time since only the small section is difficult; also, in practicing the small difficult part without interruption from the rest of the line, the synapses of the nerves are more quickly trained.

5. Muscular strength

a. It may be found that the source of unrhythmic movements lies in the weakness of certain muscles. Rhythmic movement requires a surplus, not a minimum of strength. If the question is one of individually weak muscles they may be developed by special exercises.

b. I have used the following exercises for developing finger strength in violin teaching with excellent results. Its principles can be applied to all movements.

1. Keep the entire hand still and unmoving resting in the position of actual work. Move one finger through the motion which is used in playing, but exaggerate its action. This motion should be made as quickly as possible, and at the end of the motion the finger should stop suddenly remaining stiff and motionless for about ten seconds. In returning to its original position, the finger should move again as quickly as possible, stopping with equal suddenness for ten seconds before resuming.

2. This is a localized exercise and no other muscle is permitted to move or be influenced by these movements.

3. As soon as fatigued the finger should be rested while another muscle is exercised.

4. Muscles are quickly developed with this concentrated exercise.

6. The final co-ordination

a. Last comes the performance of the operation on the basis of the previous preparation. This is the crucial moment of training. The new final pattern must show that in actual work none of the freedom of the original pantomime has been lost, only that it has been modified.

b. If unrhythmic motions appear, the original pantomime should be repeated again until it can be woven into the actual operation.

Machine Rhythm Versus Human Rhythm

Human Rhythm

We are aware of the controversy concerning man's enslavement to the machine. One group underlines the despotism of speed imposed by a machine, while the other points to increased production and lessened fatigue due to the automaticity of the machine. Although both sides possess an element of truth, progress lies neither in the abandonment of the machine nor in subservience to its will.

One improvement will be the 4 or 6 hour day. The other, to subject the machine to human rhythm.

One of the best examples of precise and unwavering human rhythm is the beat of a negro jazz band. Yet no accurate metronome will synchronize even for a minute with this "steady" beat. If this is so, how much further from mechanical rhythm is the natural rhythm of the average worker. It is this indefinable unheard variation between human and mechanical rhythm which must be bridged if the rhythm of production is to be harnessed for humane industrial production and the natural body rhythm be employed not only for non-machine work but for other tasks as well. How this can be done is problematic; the following suggestion may offer a solution:

1. The operator is equipped with earphones through which he receives the rhythm at which he will work, this beat being furnished not by a metronome but by the humanly created rhythm of an orchestra on a phonograph record.

2. He is permitted to regulate the speed of the record with a dial to select the most comfortable beat.

3. To vary monotony he may change the speed during the day.

4. The movements of the machine are harnessed to his rhythm with a photo-electric cell which controls the machine and which is in turn motivated by a movement of the operator.

The advantages of this, as yet untried experiment, are as follows:

1. None of the advantages of natural rhythmic motion are lost at the machine because of an imposed rhythm.

2. The feeling of controlling instead of being controlled by the machine is a prodigious psychological factor, especially where an element of danger is involved.

3. Factory noises with their accompanying evils are shut out by the earphones and music.

4. When the sense of hearing participates in an activity, greater concentration and less strain are achieved.

5. The sound of music assists the rhythmic quality of the movements.

6. Change of records and speeds reduces monotony.

Conclusion

The fundamental nature of rhythm has here been stressed. As an underlying principle its influence is felt in every phase of time and motion study. As it was impossible to touch upon all of these, only several of the most important fields were treated, and these, of necessity, in a fragmentary way. Enough has been included, however, to justify the thesis of the rhythmic approach to all problems of motion study.

The reality of the rhythmic relationships of the body show that the work of the time and motion study man is only begun when the improved simo-chart has been drawn up and the instruction card written, because no quantity of verbal, motion picture or diagrammed instruction can make up for the lack of an active teaching of ballistics in rhythm.

But not only for teaching is the rhythmic method superior to the analytical one. In the discovery uneconom-

(Please turn to page 26)

Staff Organization for Control[1]

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THE war effort and its many and varied problems has accelerated the growth of a relatively new profession, which, for lack of a better name, is called "Industrial Engineering."

The failure of management to understand and realize the full need and position in the organization of this function has caused it to suffer many times unnecessarily. For example, to some managers it is merely the taking of time studies and instituting wage incentive plans based on these studies. This practice was all too common in the past, and still exists to a degree. That narrow vision of the field of industrial engineering has, in my opinion, done more lasting harm than any other single misuse or misinterpretation. Time study and wage incentives are but phases of the over-all scope of industrial engineering.

Then, too, in the past overzealous and improperly trained individuals have caused the idea to enter the minds of superintendents and foremen that the industrial engineer is coming in either to take over his department or—at the least—to tell him how to run it. This, of course, is a misconception.

Industrial engineering is not a substitute for good management; it is a tool of management that enables management to become better. Industrial engineering is a concept of management—an analytical approach to problems to reduce them to their simplest terms, to their simplest operation, to their simplest solution; and then to establish positive control over them in the simplest way. Of all the definitions I have heard of this function of management, I think Alfred P. Sloan's is the best. He states, "It is a constant search for facts—the true actualities—and their unprejudiced analysis." From a shaky and uncertain start, it has achieved a prominence today that it might have taken several years more to achieve under normal conditions.

All levels of management realize today the necessity for accurate production information, simple yet positive controls, and the need for competent staffs to aid them in coping with their problems.

Management, too, has come to realize the necessity for centralizing in one group the development of its controls, procedures and routines. Out of this realization has come this new function of management called "Industrial Engineering"—or some similar term—whose duties and responsibilities include such functions as:

1. The analysis and development of proper organizational lines of responsibility.
2. The development and maintenance of administrative and sales budgets, including sales forecasting and market analyses.
3. The analysis, establishment and control of all office routines and procedures.
4. Salary and Hourly Rate Structure and Job Evaluation.
5. Time and Motion Study.
6. Plant Layout.
7. Wage Incentives.
8. Manufacturing Budgets.
9. Equipment Requirements.
10. Production and Inventory Control Procedures, and such allied functions as tool design, methods and routing, and the like.

One's first reaction is that this is a large order. It is—and it must be if management is going to assure positive, effective performance of these functions. It is a major function of management, and as such, the head of this division in a company must report directly either to the President or to the Vice President and General Manager, the same as the head of any other major function.

These functions of analysis, interpretation and control must not be separated, since they depend one upon the other to such a great degree that to separate them is to weaken them and nullify their value. To fail to give this function its proper position in the organization—in so far as recognition and responsibility is concerned—is to minimize it to a degree that greatly lessens its value.

For the purpose of this discussion, let us consider the production end of management, and turn to a closer examination of how this function operates and what its contribution is to the successful management and operation of a plant.

[1] Paper presented before the Society of Time and Motion Engineers, Industrial Management Council, Rochester, New York, March 9, 1942.

The supervisor of this function in a plant reports directly to the plant manager and functionally to the head of the division in the central office. The division head in the central office retains full functional responsibility for the performance of this work in the plant. Since this function is a staff one, it is essential that the proper relationship between it and the line organization be worked out in detail. Therefore, it is logical that the entire program in that plant be built around the plant manager and around each department head and his assistants. It is their program and they should actively participate in it. In order to emphasize this point, I believe it best to have permanent staffs of engineers in each plant, who, through the head engineer, report directly to the plant manager rather than to have a large staff of engineers in the central office servicing the various plants, with no feeling of responsibility to the plant management.

If we do this, the engineers feel themselves to be a definite part of that plant organization. It enables them to know personally the people who work there and in turn be known by them. They are able by repeated good performance to earn the respect and good will of the supervision and men, and so increase their usefulness in the plant. They are able to establish a reputation for competence, for fairness and for the friendliness that is so essential to the successful development of this work. Let me emphasize the friendliness standpoint, because so much more can be gained through this type of relationship than through a cold, distant, impersonal one.

Therefore, since the industrial engineers are considered primarily a staff service for the operating heads, their function should be to aid supervision in analyzing methods and operating conditions for the purpose of improving costs and efficiencies, and to *make a better product, at a lower cost, at the right time.* The department head is often aware of the improvements that might be made in his department, but because of the pressure of direct supervisory duties, he must rely on the engineers to develop the required studies in detail. You can see that it is the responsibility of these men to make a survey and analysis, following a well-defined program outlined in conjunction with the plant supervision and developed with their guidance and assistance. To this end the engineers can devote their full time, thus obtaining the objectives of improved operations and reduced costs earlier than would otherwise be obtainable.

It is logical that a program of this nature would make first gains in cost reduction. Then the department supervisor must step in and consolidate the gains made. He must be the driving force back of a sustained work simplification and cost reduction program in his department.

No one knows better than managers that the past ten years has witnessed a remarkable change in the status of department heads and foremen. Today they must be leaders of men; they must be managers; they must know how to use the common tools of management.

It would be hard for top management truthfully to deny that they have failed in helping men in supervisory and contact level positions to become trained in these new qualities of leadership and management that they are now forced to use daily.

Management Conferences

For a function such as industrial engineering to become successful, supervision must play a leading role in its development. They must accept it as their own, and by their own enthusiasm for it, their own belief in it, become the driving force behind a never-ending campaign to *make this better product, at a lower cost, at the right time.* Today, as never before, it is vital for the safety and endurance of our country that we make this better product at at least a justifiable cost, but primarily at the right time. Yet, how many men in supervisory positions have had the opportunity to obtain the necessary background to assume honestly and successfully their required role in this respect, as well as in the many other phases of their responsibilities?

Therefore, we earnestly recommend that management conferences be instituted at the beginning of an industrial engineering program in a plant. The sole purpose of this program must not be to teach supervisors how to take time studies or how to make motion studies: the training program should be more fundamental than that. We believe it should include the underlying philosophies of modern management, the fundamental economics back of such problems as the introduction of labor-saving machines in industry, the fundamental facts of "Where will continued profits come from?" and "What is our industrial goal?" Every man should be given a good background in his own industry, his own company, its policies, practices and plans. He must be given a good background in what constitutes a good foreman from a human relations viewpoint. He must be taught the fundamentals of what is called "modern" or "scientific management."

Then with this background and a continuation of this

type of conference, we are ready to start actual work on the fundamental principles of industrial engineering, by having the foremen and supervisors work out for themselves simple problems from their own departments. This is not only done from a work simplification viewpoint but salary and hourly rate structure, manufacturing budgets, and every type of control that we are now asking our supervision to understand and use must be studied and discussed. There is no better way to understand a tool or device in use than to study it and then help to develop it.

It is easy to see that such a program, when properly conducted, would generate great enthusiasm on the part of supervision. It gives them something tangible to put their hands on; it gives them facts and figures and a basic understanding with which to meet the many perplexing problems put to them daily.

The point is that it is vital that department heads recognize that they are the managers of their departments. It is vital that every staff function recognizes this too and realizes that the proper relationship between these line and staff people must be developed; they must understand each other's duties and responsibilities; and must understand and learn how to work with each other to the maximum over-all good. It must be remembered by all that regardless of how well a system, routine or layout is developed, if the people who have to use it or operate it do not understand it or believe in it, it will fail. Therefore, the importance of this first organizing or preliminary phase cannot be overemphasized.

What then is the *first step* in a program? It is to sit down with the head of the department and discuss the proposed analysis thoroughly, covering carefully the problems involved, the workers involved and the goal to be reached. It would also include many other things: helping him dispel from his mind that his operation is so complex or varied that measured standards or controls or improved processes cannot be applied successfully in his department. The management conferences discussed will do much to overcome this doubt, since a department head and his assistants will select typical situations from their own department and work them out for themselves.

After a common understanding is reached, a tangible general program is laid out with their co-operation and assistance. It is now possible for supervision to explain the program to the men and answer the majority of the questions they might ask. Then, too, from the beginning the supervisor feels definitely that it is his program and not just something handed to him. You know we are all interested in our own thinking and in our program, so it is essential that the supervision make this program their own. Also, we are firm believers in outlining generally the purposes and goals of this program of analysis and fact-finding to the workmen as a group, at that time explaining fully and carefully what we wish to attain, and by the use of motion pictures, charts, and other devices give them a good understanding of how these goals are to be attained. From the beginning it should be emphasized that it is a Waste Elimination Program and not a speed-up program. Every effort should be made to get over to them the idea that there is a difference between work done in a hurry and work done at high speed. Even though meetings are held with the men, the engineers and supervision should see to it that as each man is approached or his operation studied, the problem is discussed with him. If done in the right manner, his confidence and co-operation will be attained, thus insuring a satisfactory relationship with him.

If such a program is to be developed successfully, it is as requisite that the engineer be able to sell himself and his methods to the people to enlist their confidence and full co-operation as for him to be able to make the study and the analysis in the first place. Misunderstanding and distrust are the basis of any opposition to such a program, because men ordinarily fear only that which they do not understand. The first thing, then, that supervision and the engineers must do is to remove any trace of misunderstanding or lack of understanding. The men must be encouraged at all times to ask questions, and every question—regardless of its simplicity or complexity—must be carefully answered to the satisfaction of the individual. They must be shown results and work sheets to the degree that they are interested. In that way, any mystery is removed.

The use of motion pictures of the "before and after" type are extremely valuable in this respect. In fact, as time goes on and conditions permit, we recommend that a simple training program be developed for selected key people from the employes' ranks so that they, too, may learn the fundamentals of what we are trying to accomplish. Some of the next great strides in improved operations are going to come through teaching our employes what we are trying to do and how we are trying to do it, by appealing to their intelligence and to their strong desire to have a part in working out their own destinies. Why not take them into our full confidence? If any of our practices or procedures cannot be justified to our people, we had better do away with them and do it

quickly. I cannot too strongly emphasize this point of square-dealing in the successful development of any Industrial Engineering Program.

Development of Plant Program

With that all too brief discussion of the relationship between the engineers, men and supervision, let us now discuss a *typical plant program* and how it is developed.

It is essential that the problems of the plant as a whole be understood and studied before work is started in any one department. Also, it is essential that those phases of the operation which affect the over-all plant be studied and analyzed in conjunction with departmental programs. Therefore, ordinarily, the *first eight steps* of the program deal with the over-all plant:

1. is the initial inspection and survey of the plant to become familiar with its general layout, controls and its people. Thus a picture of the plant as a whole is obtained and a general idea of what may be accomplished is gained.

2. are the discussions and meetings with supervision and department heads to reach a common understanding and agreement on the goals to be attained.

3. is the development of a summary of operations with flow diagrams of the entire plant. This gives the engineers and supervision a conception and understanding of the layout and flow of production of the entire plant. It may indicate that a thorough study of the plant layout is necessary to change the type of control; that is, product control, process control, or a combination of the two before starting a detailed departmental study. Sometimes this will disclose faulty general layouts, and may suggest the combining of departments or the elimination of departments or functions, or changing the sequence of the flow between departments. At least it will enable everyone to get their feet firmly on the ground and will prove a fertile source of ideas.

4. is the preparation of a Forms Manual, including every form used in the plant organization. This serves as a basis for the office procedures analysis, which is to be carried on in conjunction with departmental programs, to simplify every office procedure and routine in the plant, keeping in mind how it ties in with the over-all picture, to reduce paper work to its simplest terms, to standardize forms and the like, and then place a positive control over the simplified procedures to see to it that they stay simplified.

5. the institution of a salary and hourly rate structure program, including the preparation of job descriptions, the evaluation of jobs, the establishment of the structure, the development of lines of progression, and the establishment of review periods for every employe in the plant, and the maintenance of wage surveys.

6. —and, in my opinion, one of the most important—is a detailed study of the organization of the plant, its duties and responsibilities, the span of executive control, and the lines of responsibility and co-ordination, to make certain that it is as simple and positive as it should be. If not, then a new organization plan should be developed clearly defining every individual's duties and responsibilities, to whom they report, for whom they are responsible, and the lines of co-ordination between functions. Today, when industries are faced with conversion for war, rapid expansion and the like, one of the first things that has broken down, and one of the most serious dislocations, has been our bulky, cumbersome and antiquated organizational setups. It is not uncommon to find a plant manager with as many as 27 people reporting to him. Yet the accepted maximum span of good executive control is 7 people reporting to one individual.

7. is the analysis of the production and inventory control problem in that particular plant, to develop a satisfactory and modern control over these vital functions. Here, again, there have been serious dislocations due to war production demands.

8. is the development of manufacturing budgets to the degree possible at that time and the analysis of trends and costs including the profit potential in the business.

The remaining section of this program affects individual departments, and ordinarily where you have a limited group of engineers working—and today they are so scarce that you surely have a limited group—you select a department for study based on the logical sequence of the flow of work through the plant and the number of employes involved. This will usually be the department wherein the first stages in the manufacturing process take place. It is important that you start in one of the first process departments, because here you may find opportunities disclosed by your detailed analysis to combine succeeding operations now being performed in other departments with processes in this first department, thus simplifying your entire process.

The *first step* in a departmental program is the Performance and Cost Reduction Survey. This survey provides a detailed analysis of present personnel, production, labor and material costs, and their distribution. It provides a measuring stick against which all proposed changes must be measured in order to justify

their being made. We firmly believe that every proposed change should be weighed by comparing its possible savings against its probable costs.

The *next step* is the meeting of the employes to tell them simply and clearly the *purpose* of the project.

The *third step* is to decide the starting point in the department for detailed analysis and study.

The *fourth step* is a detailed analysis of existing conditions, equipment, specifications and materials used.

It is here that the actual work simplification program starts. Work simplification means just what it says. The attempt is made to reduce work to the simplest possible method of performance. This involves a complete detailed analysis of those things affecting work in a department. These are equipment, materials, material-handling, methods and specifications. Every element and item must be questioned. Every phase of work done in a department must be questioned. Every phase must be subject to four standard specific questions. These are: Can it be eliminated? Can it be combined with another operation? If not, can the sequence of the operations be changed to effect economies? If not, can it be simplified?

Entirely too much time has been spent measuring and studying an operation which should never have been performed in the first place. In a war economy, production is vital; thus today this phase is extremely important.

When we speak of waste elimination, then it can be seen that we mean not only waste of materials, we mean proper utilization of equipment; we mean waste effort; we mean waste space; we mean waste power.

A study of equipment should include not only the determination of the proper feeds and speeds, but must include the consideration of the obsolescence, the state of repair, and the effectiveness of the equipment. If in this study we find that certain equipment should be replaced, an engineering estimate must be prepared showing the comparative cost picture of the new versus the old equipment, and the length of time required for the new equipment to pay for itself. If on this basis the new equipment cannot justify itself, then it should not be purchased. This same engineering estimate should be prepared on all proposed layout changes and other changes suggested which involve the expenditure of money. In other words, each one must prove it can pay for itself before it is made.

Clean-cut complete specifications are essential to proper quality and cost control. Specifications of production, if not already existing in the proper form, must be prepared. As each step of the operation is analyzed, a control to protect quality of product must be established. Methods of spot-checking, sampling, or actual full inspection must be designated for this purpose and tied in with any wage incentive plan which may be instituted at the end of the original program.

Materials, their conservation, suitability, and possible substitution, must be covered in a complete analysis program. It is surprising the number of companies whose materials costs far exceed their labor costs or any other single unit of cost. Therefore, we must be extremely careful to watch for waste dollar leaks.

The war has forced on us the necessity for studying such causes as design waste, process waste and spoilage waste.

Our inability to get certain materials has forced us into finding substitutes, many of which will remain even after material restrictions are removed.

The *next step,* then, would be the *analysis* of the *flow of work* through a department, and the simplification of this flow. This involves the drawing of a flow diagram chart of the department as it now exists to study for purposes of simplification.

Work simplification is not a process of speeding up; it is not a process of setting standards to encourage people to work faster. When we add a man to our payroll, we are purchasing from him that which he has to sell—human effort. He can only expend so much effort in a given period of time. If part of this is spent on ineffective or unnecessary motions, it is sheer waste. If part of it is spent using inefficient tooling or waiting for materials, it is sheer waste. Therefore, it is management's responsibility to analyze thoroughly all work performed to reduce it to its simplest terms and thus get the maximum utilization of the effort purchased from our people.

Without such a study you are merely asking people to hurry and work faster and perform all elements of the operation at a higher speed, including those which should never have been in the operation. That has led to the cry of "Speed up."

Such drastic changes require considerable training on the part of the employes, and the skill and understanding used in this training have a great deal to do with the acceptance of new methods. Therefore, the engineers and supervisors must realize that until the operators are fully trained in the new methods, they are not acceptable methods.

After every operation in a department has been so analyzed, we are then ready to develop the new layout.

By that time time studies have been taken, if necessary, to determine proper equipment requirements. Then, using the sound principles of good layout practice, the department is laid out on the basis of these determinations. It is wise here to make a complete check of all specifications in a department after these changes are made. We must assure ourselves that our specifications are complete, our quality controls are adequate, and our material and equipment requirements fully met. We must check our scheduling and production control system to make sure it is adequate to meet the needs of a steady flow of work through the department.

Now you have done everything that can be done to eliminate waste from a department. You have the best equipment you can have at the moment, the best layout, the best methods, the best specifications and the best quality of control you can develop at that time. Now and only now are you ready to start taking time studies to establish measured standards on the operations as they are now being performed.

Establishing Measured Standards

To have brought the program to this stage requires thoroughly trained engineers. It is just as important that this next phase—that of establishing measured standards—be done only by trained and qualified men. The primary function of the actual time study is to measure the amount of work required to perform an operation. The accuracy with which this is done is vital from a labor relations standpoint, since it serves as a basis for payment of bonus. It is also vital from a cost standpoint, since it serves as a basis for standard costs and budgets.

Data developed by time study have a number of major uses. Among these are:

1. Basis for payment of bonus.
2. Basis for standard costs.
3. Basis for departmental operating budgets.
4. Use in cost estimating.
5. Use in re-designing layouts, equipment and products.
6. Development of standard data for use in all plants of the company.

To develop data that are used for such a variety of purposes requires that these studies be made in detail and with accuracy.

What are we after in this matter of developing standards? Is it not to develop a standard for performance of work? This standard is not to be what a superman or a below-average man, an old man, or a young man can do, but what we expect a normal worker to do in the performance of his job. This standard is to be set on a fair, honest and equitable basis, not requiring killing exertion, but at the same time requiring a normal day's output. It must not be a tight standard or a loose standard—but a *right standard*. Once we have established the amount of work we would consider normal in a company, then standards for every operation within the company should be established on that basis. And standards between plants on the same operations must be identical, or if they are not identical, the reasons why must be known and measured.

Controls

We have now reached the stage where we not only have simplified our operations, have the best layout we can develop, but have measured standards on the operations. We are ready to institute the controls which will help consolidate these gains and help lay the groundwork for future improvements. One of the major devices used to achieve this end is the institution of a wage incentive plan. Moreover, even though it might be decided not to install a wage incentive plan, the program up to this point would be exactly the same.

The natural evolution of such a program, including the incentive installation, is the development of these various controls and measuring sticks. We believe these should be kept as few as possible and as simple as possible.

In connection with the incentive plan, I believe there should be two regular reports. The first is the regular Daily Bonus Earnings Report, which is posted in a department; and the second is a Monthly or Semi-Monthly Performance and Cost Reduction Report, prepared for the department head. This latter report is based on data developed during the pre-installation survey. Then you are ready to start measuring the effect in dollars and cents of all the cost reduction work in that department against the cost found during the pre-installation period. This includes all simplification effected at any time after the original survey.

In addition, a Daily or Weekly Budget Report, is recommended depending on the type of the operation. Sometimes this can be combined with your Daily Bonus Report. This places in the hands of the department heads the story of their operations against the budget and standards they helped establish. It must be given them while the information is still hot so that they can

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Making Management Negotiation Persuasive[1]

By R. CARTER NYMAN

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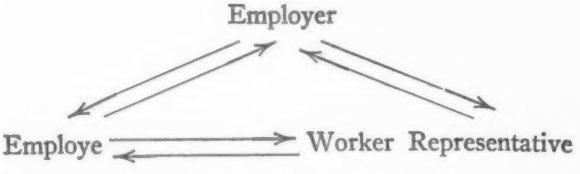
ONE of the strangest shortcomings of management is the inability of otherwise competent executives to negotiate effectively with worker representatives or groups of employes. This has been commented on recently by two representatives of labor unions in the steel industry. They have observed that sales-managers or purchasing agents seem better able to negotiate with labor than production managers who have the responsibility for managing labor.

The reason for this is easily determined. Salesmen and purchasing agents are accustomed to dealing with customers or vendors over whom they have no authority. They consequently get the habit of approaching a selling or buying problem in terms of the other fellows' interests. They must, if they are to do their jobs, *persuade* those they deal with that it is to their interest to buy or sell. A salesman or purchasing agent also gets accustomed to listening to the other fellow's story and to regarding him as having an equal and self-respecting status. Men who make a success of buying or selling must also have some aptitude for persuasive discussion. Moreover, they must always approach a situation bilaterally—for unless a deal is mutually satisfactory to both buyer and seller, enduring and mutually profitable relations are not likely to be maintained.

General managers, plant managers or foremen, having authority and preoccupied with the technical problems of production are, on the contrary, given no such incentive to "sell" their ideas to labor. It is also easy for them to rely on their authority. For it is always easier to issue an order than to "sell" a foreman or group of workers the idea that if they work in a certain fashion both they and the employer will benefit. Then, too, production executives are all too frequently selected because of aptitude for and skill in the techniques of production—engineering, mechanical operation or organization. While more and more, with the development of automatic machinery, production jobs have become labor management jobs, and while foremen are more and more selected because of ability to lead men (or, regrettably, to drive them), foremen or plant managers have not been brought up in an environment of negotiation. Most of them have had no occasion to learn or practice the art of selling.

This has curious results. It is an underlying reason why collective bargaining becomes acrimonious bickering. It is a reason why plant executives and labor leaders often argue at cross purposes and with growing resentment for hours. It is a reason why honest bewilderment on the part of employes is often mistaken for pure cussedness. But, worst of all, it frequently only intensifies the underlying frustrations of employes, stimulates them to unreasoning aggressiveness and results in the intensification of old conflicts or the creation of new ones. The integration of labor relations' conflicts not only requires a soundly reasoned solution—the employes or the managers must be persuaded that the solution is adequate and acceptable. All too often, inability on the part of executives to "sell" their ideas to the employes results in resistance to or rejection of a soundly thought out plan.

Managers of labor need to bear in mind that the sound handling of labor relations demands two-way education—education of labor by management and education of management by labor. This is precisely the case in selling or buying. The seller must educate the buyer as to how his product will serve the buyer's needs. The buyer must give the seller an understanding of what his needs are. When a third party, such as an agent or a union organizer, is injected, the situation is somewhat complicated. Then there are three lines of communication or education. In labor relations these are:



As this diagram shows, if the employes present their case through a worker representative the employer must get their views secondhand. The same, in reverse procedure, is true of the employes. In this line of communication there is danger that even the most honest and intelligent representative may not give either em-

[1] This article is a chapter from a forthcoming book by this author.

ployer or employes clear understanding. The same situation exists if the line from employer, to employe, to worker representative is used. The only channels by which clear understanding can be assured are the direct ones between employer and employe or between employer and worker representative. In consequence, whether or not the first channel of communication has to be used, it is essential that a check be made by using the other two. For example, if management wants to be sure that the employes get the same information as is given to the union organizer, it should also be given directly to the employes. Or it should be given directly to both together.

Appreciation of this typical buying and selling situation is a first essential if management wishes to achieve mutual understanding with labor. Failure to appreciate this has led management into dealing with unions exclusively and to forgetting to deal with and inform the employes. In fact, it has resulted in management becoming so absorbed in working out relations with unions that in many instances management appears to have overlooked the existence of the employes—who are in truth the second principal in the labor relations buying and selling situation.

Management, also, if it wishes to enlist employe support and co-operation and get the understanding essential to this, must realize the underlying attitude of most employes. While all employes may want to fight management once in awhile, most of them do not want to do so all of the time. But neither do employes want merely to work *for* management. What most employes really want is to work *with* management. If workers are to be persuaded to accept management's proposals or if they are to have a right chance to persuade management to accept their ideas, they must be approached with a recognition of this attitude of desiring to work *with* management. Failure to do this has at the start jeopardized many well-intentioned plans of management and caused labor relations conferences to become futile wrangles.

But is such an approach practical or possible when an aggressive labor organizer is present—or when a rebellious shop steward is representing an employe? Admittedly, such an approach is made more difficult. If, as often happens, the organizer has assured the employes that he will walk into the boss's office and "put the screws" on, the employes may well be in a mood to see just this done—and to relish the experience. This, however, does not change the basic situation. It only means that the employes need be made conscious of their underlying desire to work *with* the boss if he is willing to work *with* them. There are several ways this can be done. The aggressive organizer can be allowed to "blow off steam" and then the real discussions can be postponed for a cooling off period. Another way is to talk *at* the labor organizer but talk *with* the employes.

But whatever the case, the first necessity is for management to back its engine onto the employes' train. However much a labor leader may insist on having all relations with employes conducted through him, and however convenient this may be, if employes are to be persuaded they must be given direct understanding and given an incentive to try to understand by approaching them on the sound assumption that fundamentally they want to work *with* management if they can.

As has been suggested, an obstacle is the prevailing attitude of labor union leaders. Labor unions need to change their attitudes and methods. Labor leaders, like employers, need to realize that labor does not want to fight management but wants to work *with* it. Union leaders have got to get over the idea that they can only win and hold support by always "getting something" for labor or that their security depends upon such artificial means as the "closed shop" or the "check off." They have got to learn that what labor really wants is the kind of representation that will enable it to work *with* management so that the mutual interests of employer and employes will be better served. It may be that labor needs to be educated to the fact that this kind of representation is worthwhile and worth supporting a union and paying dues to have. But labor leaders as well as employers have underestimated the common sense of working men and women in this respect. Still, if the attitudes and methods of labor unions present obstacles to an intelligent working out of labor problems with employes, it is up to management to bring about a change in the right direction. And this can be done if management will but give employes the understanding and confidence that they can work together.

Whether the objective is determination of the real nature of a labor difficulty or putting into effect some plan for integrating a labor relations conflict, management must take as a starting point the attitude, understanding and interests of the workers. Obviously, this means that management cannot afford to come into conference with its emotions out of control and resentful of what seems to be unwonted rebellion, aggressiveness or stupidity on the part of labor. And if the underlying desire of employes to work *with* management is submerged in a storm of tempestuous emotion on their part,

effective negotiation is impossible until the atmosphere is cleared. Often the attitude of feelings of the employes must first be dealt with before the labor management problems involved can be taken up. It is frequently difficult for executives accustomed to going directly into the subject matter of a problem with other executives to realize this. They are all too prone to forget the difference in status which may have existed between management and employes and that the latter, without understanding or security, may be subject to feelings of resentment or futility to an extent making it impossible for them to use reason until these feelings have been overcome or worked off.

Assume that management knows the issues and facts realistically and realizes that even so it may not know the whole situation. Also assume that the issues have been analyzed and evaluated from the employes' point of view as well as from the employer's. Assume further that management comes into conference with an understanding of the prevailing attitude and the interests of the employes and is prepared to approach the problem from this end. Then what principles can be followed to assure a working out of the situation by means of "persuasive education"—by the development of mutual understanding and the development of mutual desire to contrive a solution effectively serving all of the interests involved?

The first principle is that rapport must be established. That is, management must convince the employes or their representatives that the approach will be friendly, factual, and that issues will be dealt with judicially—with due regard for all interests—as mutual understanding of them develops. This can be established by patiently listening while the employes or union delegates blow off steam, by giving convincing evidence of real interest through displaying sympathetic attention, by tone of voice, expression and posture—even by a rugged firmness in meeting outrageous demands or accusations. But whatever conduct seems indicated on the part of management, the objective of raising negotiations to a level of intelligent reasoning must be shown and achieved. Better to spend hours and postpone consideration of the questions involved until this has been done than to try to negotiate in an atmosphere of suspicion, fear or resentment. For if negotiation is to be effective, management must have control of itself and of the situation.

The next principle is that the process of negotiation must be organized and given structure. The position and responsibility of each of those present should be clearly determined and understood. An orderly consideration from finding and getting agreement on facts, through interpretation of agreed upon facts, to decisions based on facts must be provided for by making the steps to be followed clear to all. It must be made clear that adequate time will be taken to get the facts and understanding of the facts on the pertinent issues and that other issues will have to be considered at other times and will not be allowed to clutter up the discussion. Yet management must take care to give full opportunity for expression by labor and for a roundabout approach to the issues involved if necessary. Just how this can be accomplished depends too much on the particular circumstances to permit the use of any formula—but if management realizes that the process of negotiation must be organized it can, by the use of reasonable intelligence, do much to make labor negotiations orderly and co-operative.

So long as the issues are appreciated or provision is made to admit pertinent new issues and so long as the approach is in terms of the employes' point of view, it makes little difference what issues are taken up first. But it is essential—and this is a third principle of negotiation—that the consideration of the issues converges so as to clarify the fundamental problems. To make sure of this, management should, as the discussion progresses from one stage to another, summarize and establish what has been brought out in each stage; that is, make sure that mutual understanding has been developed. Again, how this can be done depends upon the particular circumstances and the intelligence and skill of the executive participating in the discussion.

A fourth principle of negotiation is that discussion must throughout be adapted to the characteristics, backgrounds and methods of the employes and their representative. This means that management must try conscientiously to realize what they are experiencing, and so far as this can be understood, management must avoid words or acts which embarrass or create resentment, and must encourage and reassure. To adapt discussion to the employes the case must be put in terms of the employes' experience, language or ways of thought. In discussion, for example, a careful but highly technical and academic statement may prove worse than futile for it is verbal evidence that management is not thinking in terms workers can understand and, worse still, is evidence that management cannot or is not trying to understand them. Such adaptation is of the utmost importance because the willingness of employes to try to understand or to accept decisions is far more dependent on the proof presented by management of

fairness, appreciation of their difficulties and generosity of attitude. This is much more a matter of what management *shows* than what it *says*.

It is easy in negotiations with labor union representatives or aggressive employe groups to indulge in the practice of trying to out-trade the other fellow. A good deal of temporary satisfaction can be gained by indulging in tricky or shrewd moves which outsmart the union organizer. Union organizers can and often do enjoy playing this game, too—and are frequently more skillful at it than industrial executives. But the process of persuasive education, while basically a sales process, is not a trading one. It has the objective of developing a mutually satisfactory relationship, not the objective of out-trading the other fellow. If any permanently constructive results are to be achieved in labor relations negotiations, mere "smart" trading accordingly must be ruled out. If the underlying desire of employes to work *with* management is to be cultivated and if means making it possible for them to work with management are to be developed, management must be honest and genuine in negotiations with employes. This applies in dealings with individuals, with informal groups or with organized labor. The executive who says the way to treat labor is to "kid it along" or the management which distributes copies of a financial statement printed by a three-color process and worded in Mother Goose language but which does not honestly meet the employes' issues only wastes breath and money. "Hard-boiled" honesty is better than any hypocritical sympathy. For if workers can sense anything, they can sense falseness and feel the "real thing" in their bones.

A final principle in the process of persuasive education is that in negotiating with the employes or their representatives, preliminary plans or proposed solutions must be adjusted to the situation as it develops. In other words, if conferences bring out a condition overlooked or previously unknown, management must be ready and able to readjust its beliefs and plans. The situation must be dealt with as it actually develops not as even careful preliminary analysis and planning has indicated that it ought to develop. Care must be taken, of course, not to make superficial readjustments on the basis of expediency but to work out a fundamental solution. This does not mean that sound practical readjustments cannot be made—for almost any predetermined plan requires practical adaptation to practical conditions.

While the process of persuasive education requires observance of the principles which have been referred to, it consists essentially of (1) giving and getting the facts; that is, a bi-lateral determination of the essential facts of a situation; (2) an equally bi-lateral examination, explanation and interpretation of the facts so as to bring about realistic mutual understanding; and determine the real problems or needs; and (3) working out a solution which can be voluntarily accepted by both management and labor. In using the process, professional knowledge is advantageous but patience, sincerity and common sense are indispensable.

All of the foregoing principles apply and must be observed whether the problem is a simple one such as changing the duties of an individual employe's job or whether it involves developing a workable relationship with a labor union. In any case, both management and labor must obtain realistic understanding and be brought to see that the change or solution will be mutually beneficial or that it is the best that can be contrived considering circumstances which cannot be controlled. Unless this is done, labor must always be concerned primarily with protecting itself against arbitrary orders or management acts which threaten labor's interests. Admittedly, the process of persuasive education takes more time, care and patience. Admittedly, practice, experience and professional knowledge of the fundamentals of labor relations are required before the process can be used skillfully. Persuasive education, nevertheless, is a method management can employ effectively to gain the wholehearted support of labor and to assure that management's solutions of labor relations problems adequately take into account the viewpoints and interests of labor.

Rhythm in Time and Motion Study

(Continued from page 16)

ical motions, hesitations, etc., this method provides an automatic fault finder for the motion study man, provided he has knowledge of the following neglected factors:

1. The difference between rhythmic and unrhythmic movements.
2. The scientific use of the body as a unit instead of as a group of separated classifications.
3. How to increase momentum without increasing energy output.
4. The elimination of wasteful ballistic movements.
5. The improvement of accuracy through the relaxed execution of straight line movements.
6. The rhythmic organization of a series of therbligs.
7. The teaching of all this to the average worker.
8. Freeing the worker from the rhythm of the machine.
9. Training the body through a physical rather than a mental approach.
10. The time and motion study man studying operations through actual participation.

This, in short, is a list of the activities which I recommend as necessary additions to the practical and theoretical field of time and motion study. In their application new problems will arise and I hope that this report will have served as one of the impulses toward further progress in liberating the motion of work.

Tools For Management Diagnosis

By ERWIN HASKELL SCHELL

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SOME years ago a search was made in the literature of management for diagnostic devices—methods which the industrial analyst or management engineer had found useful in revealing opportunities for improvement hidden in manufacturing operations. Something more than a thousand of these procedures were assembled and classified in terms of the industrial activities (design, purchasing, production control and the like) to which they had been applied.

From this accumulation there were next selected one hundred or more of these professional implements which were particularly simple and effective in disclosing important areas of improvement. This smaller assembly was re-arranged to be of special service to supervisors and mid-zone officials, and published as a manual for executives and foremen.

More recently this material was subjected to another analysis and an attempt was made to group the methods into generic divisions which differed in kind rather than in point of application. A dozen attempts by different individuals were made in this direction. From these classifications a final arrangement incorporating the most useful features of the previous groupings was made.

Nine divisions appear sufficiently distinct from one another to merit definition. Nevertheless, it is easy to argue that the number should be greater or less. The justification of this choice is that in each of these groups there appears unique or exclusive areas of application not found in the others. It is clear that certain of these divisions relate more intimately to one another than do others. This applies equally to golf clubs and to continue this analogy, the purpose of this paper is to discuss briefly the field of use of each and the stance and swing which appear to yield greatest effectiveness in its use.

These devices have no best sequence of application. Rather do they array themselves as points on a multi-dimensional map. The order in which they are presented is not of particular significance although it has been found to be reasonably satisfactory in practice.

The Interrogational Attitude

There is a curious advantage in the simple questioning approach. It is what Mr. A. D. Little termed "the capacity to wonder." It may be called the "why" attitude. Not essentially critical or deprecatory, it places emphasis upon the essential reason for the activity apart from its quality of performance. A New Hampshire Yankee once remarked to me, "The quickest way to find out what anything's worth is to see what would happen if you didn't have it." To put the general question in another way, "If not performed, exactly what loss would occur?"

I was once asked to improve the effectiveness of a group of twenty-four clerks who maintained records of purchase commitments in a large war plant. The use of this question disclosed no evidence of loss and the entire activity was discontinued. It had simply outrun its original usefulness. If the same question had been applied to the plans for the huge train sheds which were built at great cost at many of our railroad terminals to protect passenger cars from the weather, large savings of erection and ensuing maintenance would have been effected. It was Elihu Thompson who said that one of the greatest enemies of reason was the preconception. This approach is a direct challenge to draw it from hiding.

Much of the effectiveness of work simplification programs rests here in the discovery of the overelaborateness of activities. After the query, "Can we eliminate?" has been satisfactorily dealt with, the question "Can we simplify, shorten or combine?" often brings surprising opportunities to light, before analysis of a more technical nature is resorted to.

The Visual Examination

Someone once estimated that eighty-five per cent of our knowledge comes to us through the eye. Certainly our most dependable initial impressions would appear to be visual rather than auditory. Facts are not so apt to be clouded with opinions when they arrive through sight rather than sound.

The visual examination rarely proves anything but it does raise questions to answers. The unusual is always apt to attract attention and the analyst who carefully weighs his initial impressions, capitalizes a useful analytical tool. Such a man doubtless has developed, perhaps unconsciously, a large number of norms which may apply to quantity, quality, cost or a variety of other factors. To give these a chance to function through comparison with operating realities is an act of common sense. Industrial congestion, confusion or delay are conditions whose symptoms are evident even to the inexperienced eye. Many years ago, my senior management engineer remarked to me, "Whenever you walk through a department, see how many men are waiting for something (and this includes work to be completed by the machine)."

To best apply this tool, one must literally get "into the other fellow's shoes." Poor lighting, fatigue, hazard, noise, unnecessary grime, inconvenience, quickly come to light when the analyst finds opportunity to go through the motions himself. An acquaintance of mine once told me of having completed a job analysis in a large laundry where he was called upon to take over, in an emergency, the routines of an operator. The worker's-eye view thus afforded proved so illuminating that the entire sequence of operations was again reviewed from this vantage point with new and important facts revealed. The first impressions of the analyst may not be entirely reliable but when realistically gained they point quickly to areas where burden of proof should rest upon present methods or facilities. The personal reaction "on location" is of marked value as an indicant of potential improvement and should be respected and given weight by the analyst.

The Study of Trends

The value of trend analysis goes without saying, but there are at least three ways in which this activity has brought good return for effort expended. One of the commonest difficulties of line management is that of constantly adjusting facilities, procedures and personnel to changing demands upon the manufacturing process. As managers, we tend too much to view our equipment, our layout, our process, our labor setup as permanent and static, forgetting that the ever-changing nature of the orders flowing through our plant is steadily rendering these resources obsolescent. Trend analyses which reflect these changes in demand almost invariably reveal that the facilities for satisfying these new conditions have not kept pace with progress.

A second use of trends occurs when a complex series of activities are not yielding results. Recommended cures are frequently plentiful at this point, and decisions are difficult. A past student of mine found himself in such a predicament when, as assistant to the president of a large department store, he was tossed into an unfamiliar department to ascertain the reasons for its failure to pull its weight in the boat. A review of operating figures disclosed an earlier period during which satisfactory operations occurred. This interim was analyzed and trends to the present operating period developed, quickly disclosing the "essential good" in the activity which, when allowed to atrophy, had brought difficulty to the department.

The third use of trends relates to the future. The management analyst owes to his client the responsibility of detecting storm clouds upon the manufacturing horizon. Perhaps the deadliest attack upon corporate security is the competition that springs unexpectedly from another industry and sweeps away a market before its presence is realized. The trend analysis which takes the inquirer to commercial associations, professional research laboratories and trade statistics sometimes points to oncoming problems which render the intensive improvement of current manufacture unwise or inappropriate. Nothing is more humiliating to the management engineer than to find that while he has been increasing quality and output, and decreasing costs, the market for the product has disappeared or turned elsewhere with its patronage.

The Graphic Visualization

Obviously, the opportunity here is great and no treatment within the confines of this paper could be termed complete. The chief value of graphics to the management analyst seems to be the ability to translate facts into self-evident terms so that to see is to be convinced. For example, if it is recognized that material flowing through a department should remain as nearly as possible in the same horizontal plane (thereby minimizing liftings and lowerings), a chart which plots vertical heights against the sequence of handlings and operations through which the part passes throws into vivid relief any variations from the ideal working height shown as a straight line drawn across the graph. Similarly, when the hourly wages of employes in a given department are plotted against length of service, those employes

whose wage is out of proportion to those of longer tenure stand out like sore thumbs. This simple picture carries a moral for many concerns today who have increased their personnel during a period of rising wage levels. To calculate the labor turnover of a number of departments; to array graphically from low to high and then to draw an average line for all through the group, again makes self-evident the departments which are in greatest need of constructive assistance.

Simplicity is the keynote in the design of this tool. The worst rebuke the client may offer is to say, "What does this mean?" and the greatest praise he can give is to exclaim, "I didn't realize that!" Graphics offer many other advantages to the analyst but an important use is to convince.

The Statistical Array

Again, opportunities are manifold for the use of the statistical tool. The trick here is to find the array that is creatively useful—that discloses the way to constructive action. In New England, tactful critics of the arts find refuge in the words "diverting" and "interesting." Too many statistical tables are limited to these virtues.

As the diamond cutter must ascertain the lines of cleavage for each stone, so the analyst must discover the array that bares the pregnant fact. A classification of employes into age-groups revealed a basis for animosities which explained an unheralded unionization of a dominanting proportion of workers in a plant which enjoyed the best of management-labor relations. In a large rubber company a number of years ago termination interviews over six months showed the greatest reason given to be the low wage; next greatest the long hours, and thereafter a variety of causes of approximately equal weighting. A statistical analysis of the same group showed that 65 per cent of those terminating were young men between the ages of 20 and 30, who were unmarried, who were not residents of the city in which the plant was located, and who lived in boarding houses. Thus the real cause emerged—the normal wanderlust of youth.

The analyst uses statistics as the cat uses whiskers—to feel his way forward. Fundamentally this tool is revelational rather than demonstrative in nature.

The Analytical Classification

As a young apprentice in a management engineering office I once asked my superior, "What shall I do in a client's plant should I have any spare time from assigned duties?" and he answered "Analze—analyze!" It was Edward D. Jones who said that analysis "improves the ratio between the difficulty of the subject and the natural vigor of the investigating mind."

Here we go a step farther. It is analysis coupled with classification which may reveal otherwise hidden and significant facts. Rarely does an analysis of spoiled work fail to bring constructive suggestions provided the causes are arranged in some useful way in point of possible remedies. A time-saving device is the over-all time study for it quickly enables the analyst to discover those elements or activities which over a reasonable working period consume the most important sector of time and therefore deserve the first attention.

Analysis and classification disclose causes, if causes are remembered to be the objective. Someone has remarked, "When your fountain pen leaks you don't buy a pair of rubber gloves." Much of analysis is pointless unless the "so-what" attitude is vigorously emphasized in our preliminary thinking. For example, the analysis of inventory in terms of the nature of materials stored may have mild significance, whereas an analysis in terms of rate of turnover of materials may reveal striking opportunities for constructive recommendations by the analyst. Likewise, an analytical classification of vendors by products supplied may be of little use whereas a grouping in terms of the length of time in which each has enjoyed the exclusive patronage of the company, may disclose significant areas for the acceleration of competition and reduction of cost.

The Numerical Verification or Check

Manufacturing is filled with marginal situations in which the criterion of success or failure is the thin film of advantage which overlays a heterogeny of contributive factors. While the accountant, or auditor uses the numerical check to verify technical accuracy and corporate honesty, the analyst capitalizes upon it in bringing to light the forgotten five per cent. For example, the analyst who follows a given lot of materials through its chronology of operations, recording at each station the legitimate scrap, preventable waste and remainder of operating stock-in-process may prove the accuracy of his investigation mathematically and be assured that all material of whatever nature has been scrutinized. Again when initiating a plant survey a rough verification of the annual operating statement with the current week's costs in terms of labor, materials and overhead serves quickly to indicate whether current proportions reflect

the characteristic operations of the business or apply to an exceptional period in the year. A revealing verification in the analysis of office routines is one which determines the average time for each operation, multiplies by the output at each operation per day and then compares totals with the total operating time paid for in the department. The reconciliation of differences here frequently opens surprising avenues for new effectiveness.

The Suggestive Comparison

The management analyst has available a variety of standards, divergence from which may properly bear burden of proof. For example, the light-meter enables comparison to be made between existing illumination and that which is considered good practice for the particular work at hand. I have experienced instances in which the comparison of working conditions and company regulations with existing State or Federal laws brought a surprising variety of constructive if not necessitous suggestions.

A more telling method may be the use of rating sheets or check lists. Many management engineers have employed these devices particularly for purposes of preliminary survey. Their virtue lies in their wide suggestiveness—their hazard in too great reliance upon their completeness. The field of plant location analysis is strewn with the wreckage of theorists who relied on a list of factors and thereby omitted the sporadic, concealed and unfortunately dominant element. The best check list I ever encountered incorporated provisos to be included in a contract between builder and contractor and had been constructed over a period of many years out of disputed points which had arisen in actual practice.

The Consultative Viewpoint

Perhaps the greatest safeguard for the management analyst is the perspective which may be drawn from the viewpoint of others. It is said that there can be no art without a creator and a critic. It is easy to criticize—criticism is cheap and frequently can be had for the asking. It is not the critical comment that is intrinsically valuable; it is the stimulus to the analyst that is precious. It is only at this stage that opinions take on a factual hue for their presence is a reality to be dealt with, irrespective of their reliability. The viewpoint of executives concerned with operations or processes subsequent to those being studied; the attitude of those collaterally or indirectly affected by contemplated improvements; the reasoning of the constitutional objector; the arguments of the salesman of competitive facilities are all useful to the analyst who in his thinking is attempting to avoid confusing the part for the whole. And it is often out of the cauldron of divergent ideas that the new and better arises. One management engineer requires his juniors to submit three solutions to each problem before presenting recommendations, in order that the open and judicial mind may be retained until the last stages of the thinking are passed.

Summary

A good case could be built upon the argument that never in our industrial history has there been more need for competent managerial analysis than today. For never in our history has there been so many rapid and radical changes in our manufacturing processes and therefore, so many new and developing procedures to be explored and constructively refined.

I have suggested that opportunities for such improvement may be revealed by:

1. Defining the "intrinsic good" in given procedures or methods
2. Examining present activities in the light of the past and the future
3. Listening carefully to our own first-hand impressions
4. Clarifying and validifying facts by graphic methods
5. Developing new contours of truth by means of statistics
6. Finding significant lines of analytical cleavage
7. Capitalizing upon the power of verification by means of figures
8. Comparing performance with standards
9. Enlisting the experience, judgment and opinions of others.

Finally, I would recall that these suggestions are not of my making. In reality, they are the final residue filtered from a considerable number of case histories,—a sort of concentrated essence of the experience of many industrial engineers.

On the Problem of Organizing for the Chief Executive[1]

By RICHARD A. FEISS

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MANY of our foremost commentators on national affairs are constantly pointing out the need for the appointment of competent men to whom the President should delegate authority to direct the various phases of our military and economic life. The appointment of the most competent men available to administrative positions is, of course, essential, especially in times of emergency. But for the most capable executive to carry on effectively, there must be a definite set up of his duties and a delineation of the scope of his responsibilities. This is organization.

In the implication that authority delegated by the Chief Executive of itself constitutes organizing, the commentators are party to a fallacy common to our business and public thinking. This fallacy consists of the conception that the functions of administering and organizing are one and the same thing, and are embodied in the position of a chief executive, whether such executive is appointed to business or civil activities, or elected to office.

Administering, or managing, is the function charged with the direction of effort in the various spheres of industrial and governmental enterprise. The chief executive, as general administrator, is responsible for the direction or management of the administrative machinery in government as well as in industry. But he should not be responsible for the planning and the setup of that machinery, or organization, any more than the operator of a machine or a group of machines is responsible for their design or the devising of their techniques of operation, or than the various trades engaged in the construction of a building are responsible for its plans and specifications.

Organizing is that function which analyzes all the activities essential to the effective carrying on of administrative or managerial duties, and sets up the various responsibilities and their relationships to one another. It follows that organizing must be done entirely from the objective or scientific point of view; that is, with the purely analytical approach of the engineering mind.

Even our industrial engineers for the most part have failed to understand this fundamental difference between the managing function and the organizing function. Although they have been a great factor in increasing the efficiency of American management in industry by the installation of certain techniques applied to physical production, they have not on the whole achieved the potentialities of their mission because of their failure to distinguish between the field of managing and the field of organizing.

Parenthetically I might say that this failure of the industrial engineers may be due to their not having grasped the significance of the work and philosophy of Frederick W. Taylor, the "Father of Scientific Management," from which all modern industrial engineering stems. They have seized upon the techniques developed by Taylor, such as time study, by which a scientific job analysis is made for the proper setting up of a production job. But Taylor's thesis consisted in applying the analytical method to the entire job of production management, as instanced by his setting up a Planning Department with its various functional responsibilities. This seems to me to be clear if one studies Taylor's *Shop Management,* which antedates by several years his more widely read, *The Principles of Scientific Management.* The former, in my opinion, could well have been entitled, "The Scientific Organization of Shop Management," as it deals largely with the scientific organization of production management and methods. These principles and philosophy of organization, by implication at least, are applicable to all managerial or administrative jobs in every field of endeavor.

Organizing is a matter for experts. The sphere of the organizing expert, or the organizing engineer, is that of devising the detailed setup of managerial activities and the techniques or methods and the rules or laws for their performance. The proper authority, having decided what is to be done by the administrative officer in a general way, must provide specifications of the activities to be administered and of all the responsibilities involved. The providing of such specifications, or job analyses, is the organizing function as distinguished from the administrative or executive function.

The distinction between the organizing and the execu-

[1] Paper presented at a meeting of the Los Angeles Chapter of The Society for the Advancement of Management, January 21, 1943.

tive functions was clearly conceived in the original instrument or charter of our national governmental organization, the Constitution of the United States, which makes clear that the Congress is charged with the setting up of every "Department or Officer" not definitely set up by the Constitution itself, while the President has the "Power" only to appoint the heads and other officers of the administrative machinery and "take Care that the Laws be faithfully executed . . ." [2]

Now it seems to me that much of our criticism of the inefficiency of the administration of our national affairs, whether in war or peacetime, is due to the failure of the Congress to set up a properly constituted administrative organization with definite specifications as to the scope and nature of its various offices or officers essential to carrying on the duties imposed upon them.

As the Congress alone has the "Power" of setting up the various governmental administrative departments, it is clearly responsible for providing the specifications and describing the scope of each department and its place in the governmental setup. In order to do this effectively in the way the situation demands and avoid the muddle and incongruities of the present administrative organization, the services of a body of organization experts is called for. Such a body, or commission, should be set up immediately.

This body of organization experts, or Organization Commission, would be responsible for the analysis of the duties and responsibilities not only of every administrative or top managerial function, but also of every other governmental position. It would eventually specify the qualifications for each position in every governmental office or department, and the amount of personnel required, based on thoroughgoing job analyses. These analyses and the consequent organizational setup must be entirely free from influence of precedent and from political considerations that give weight to the importance of any particular classification or subclassification of prime functions.

Analyses and classifications should be made of *all* the affairs, whether civil or military, with which the Chief Executive and the administrative officers deal. These classifications should be grouped according to type so that they represent each national activity as a whole under the fewest possible categories. This would keep the number of top administrative heads of cabinet rank to a minimum, eliminating unwieldiness, facilitating co-ordination, and fostering much needed effectiveness in the offices of the Chief Executive.

It is important that each major category be comprehensive enough so that all activities pertaining to one type of affairs will logically be classified within its sphere. This is basic to co-ordination in the detailed administration of departmental activities, and will give a clear perspective of the generic structure of our national affairs. Again it cannot be stressed too emphatically that these categories and all classifications under them should be determined on the basis of logic only, and must not be influenced in any way by the importance, from the point of view of policy, of any national, political or social group with whose affairs any subdivision of the classification may deal.

While the organizing process involves a tremendous amount of expert consideration and technical work, we must of necessity begin with the breakdown of the top administrative responsibility into its major functions. If this is done with the purely objective approach, there will be little difficulty in evolving a setup that will be readily understood by the average citizen and acceptable to the organization experts as major categories for the classification and co-ordination of all subfunctions.

To illustrate what such a setup of major functions in comprehensive terms of the types of affairs dealt with by the Chief Executive would be like, we submit the following:

(a) Foreign Affairs

(b) Financial Affairs. This includes all fiscal matters, and the control and the accounting of all physical assets and their disposition.

(c) Military Affairs. This includes all activities of the armed forces, on the ground, at sea or in the air, and all other activities pertaining to defense or war.

(d) Legal Affairs. This includes all activities pertaining to the maintenance and enforcement of the laws.

(e) Social Affairs. This includes all activities dealing with social welfare, such as health, education, social security, etc.

(f) Economic Affairs. This includes all activities pertaining to production and distribution, whether agricultural, industrial, or any other kind, with such sub-

[2] Article I of the Constitution sets up the legislative powers as vested in the Congress. The last paragraph of Section 8 of Article I states that one of its powers or responsibilities shall be "to make all Laws which shall be deemed necessary and proper for carrying into Execution the foregoing Powers, and all other Powers vested by this Constitution in the Government of the United States, or in any Department or Officer thereof." Article II Section 1 of the Constitution states "the Executive Power shall be vested in a President of the United States of America." In Section 2 of Article II the "Executive Power" is described. It states that the President shall be Commander-in-Chief of the armed forces; it gives him power to make treaties and appoint diplomatic officers and judges of the Supreme Court, all with the consent of the Senate; and to appoint "all other Officers of the United States whose Appointments are not herein otherwise provided for, and which shall be established by Law."

divisions as raw materials, mechanical power, man power and labor relations, etc.

(g) Transportation Affairs. This includes all activities pertaining to the transfer of men or goods by any means.

(h) Communications and Information Affairs. This includes all activities pertaining to governmental publicity, the issuing of all nontechnical information, and the maintaining of all forms of communications and the freedom of their use.

Under a few such comprehensive major departments all administrative affairs undoubtedly could be classified and set up in such a way that their fields of activity would be clearcut and free from duplication and divided responsibilities. Departments set up in this manner with their logical subdepartments could be expanded or modified to meet emergency conditions, such as those created by a state of war, without involving the inefficiencies and confusion of setting up in every emergency new and temporary activities with vague responsibilities.

This approach to the problem of national administrative organization is essential for the most effective, efficient and economical carrying on of governmental administrative activities, and removes from a controversial field myriads of irrelevant subjects the discussion of which is befogging our national thinking and our ability to work together. Inasmuch as every part of the administrative machinery and its responsibilities are specifically set up and described by the organizing function, the performance of duties is not based on nor does it involve any delegation of authority. The authority to perform any function or part of a function is entailed in the assignment of duties and responsibilities, and in the specifications of the particular job to be done.

To carry out these responsibilities on the highest possible plane, we require at the head of the nation leadership with vision, and administrative management of the utmost efficiency, obtainable only with capable personnel whose responsibilities are defined by scientific organization methods.

These principles are not consistent with any theory that all authority emanates from one man. They are based on our American conception that all authority in government emanates from the people, and that the Chief Executive, as well as all other administrators, are servants of the people and responsible to them and their elected representatives.

It is often stated that democracies must always be inefficient as compared with autocracies where all power and authority are centralized in the hands of one man. It is our belief that the very contrary of this is true, and that the inefficiencies in the conduct of our national affairs have been due to the fact that we have had the authoritarian point of view as to both management and organization. The efficiency obtainable under a setup based on a conception such as we have outlined is far greater than that obtainable under the authoritarian conception. Ours is the democratic way, and it is the efficient way.

Staff Organization for Control

(Continued from page 22)

analyze the causes of the variations and set about overcoming them.

The other reports we recommend are of the exception type. That is, they are used only when something is going wrong or something other than standard is happening in a department. These take the nature of Waiting Time and Excess Reports.

When an unusual amount of waiting time is being experienced, a report breaking it down by causes is prepared. The department head may add what is being done to eliminate it. When it has been eliminated, the report ceases to be made out until such time as it may be needed again.

The Excess Report is another valuable management tool. Often when establishing a standard on an operation, it is found that there is a better way of performing it, and yet the change cannot be made at that time. Rather than bury in the standard the difference between the way it could be done and the way it is done, we set up the difference as an excess standard. A report is made out showing this excess and its cause, so that everyone will have before them the reminder that here is an additional saving which can be achieved if we do certain things. We should not bury in our standards anything other than the actual amount of work required to perform the operation.

At the completion of such a program as this, your major work is just ready to start. Now, for the first time, you probably know exactly what your situation is; exactly what your operation consists of; and have a detailed analysis of it. Therefore, you are in position to select that operation which will yield the greatest potential savings through change.

This study may include the substitution of materials, waste control and elimination, mechanization, establishing economic lot sizes and minimum and maximum runs, re-design of product, development of new products, re-design of processes, and the like. There is no end to the possibilities in cost reduction. The major point is that now you are in a better position to know where to begin to achieve that maximum utilization of men, machines and materials required to win the war and adjust for the peace to come.

William Crozier

February 19, 1885 November 11, 1942

Major General William Crozier, Chief of Ordnance, U.S.A., from 1901 to 1918, died on November 11 and was buried in Arlington Cemetery with impressive ceremonies. Not only in his services of command but in the organization and management of the Arsenals General Crozier prepared the way for meeting the demands of World War I. In the conduct of the war and in the organization of overseas supply, he brought exceptional talents into play.

Scientific Management has become so much a matter of general acceptance that it is difficult to recall the days when the battle for recognition was on. In the discussions which raged from the presentation of "A Piece Rate System" in 1895 until Taylor's death in 1915, no single individual offered more substantial testimony to the value of Scientific Management than did General Crozier. Always the close student of any matter bearing on his work, he familiarized himself with the Taylor principles and retained Carl G. Barth to apply them at the Watertown Arsenal, Boston. His reports on the successful results were scholarly and carried special weight because of General Crozier's reputation as engineer and administrator.

It required courage to authorize this work in a government plant because of the attitude of the labor unions at that time. Even after the success of the experiment at Watertown, the unions were able to add an amendment to Army-Navy appropriation bills making it illegal to carry on time studies in any government plant. It is almost unbelievable that these same amendments are still carried year after year in appropriation bills notwithstanding the fact that labor has now come out wholeheartedly for time studies and the other mechanisms of Scientific Management when properly utilized. For this change in attitude, Samuel Gompers deserves much of the credit.

General Crozier was a great engineer and designer. But he was also, as Secretary of War Henry L. Stimson has said, "an experienced and gallant soldier with a keen analytical mind as well as breadth of vision, which made his counsel in general military matters of very great value. As head of the Army War College, General Crozier took a prominent part in the discussions resulting in the 'Report on the Organization of the Land Forces of the United States,' that historic study out of which came the first tactical organization of an American army."

General Crozier was one of the founders of the Army Ordnance Association. In explaining its objectives he said:

"The war (1917-1918) showed that the expenditure of munitions in the full swing of a conflict between great powers is so vast that to attempt to meet it by accumulation sufficient to tide over the interval from normal to required output, after the outbreak of war, would be prohibitively expensive, as well as unwise from the viewpoint of obsolescence. So our plan is to shorten this interval by making an understanding of the requirements of the Ordnance Department a part of the mental equipment of the leaders and executives of industry, and of the body of professional men whose work furnishes the scientific guidance upon which practical production depends."

When the war broke in 1917, General Crozier's first step was to bring to the service of his department every member of the Taylor Society on whom he could lay his hands. No member of this group will ever forget his courtliness, helpfulness, and his day-to-day efforts to give commendation where he thought commendation was due.

MORRIS L. COOKE

REVIEWS

Engineering Economic Analysis. By Clarence E. Bullinger, McGraw-Hill Book Company, Inc., New York and London, 1942, pages xi, 359. ($3.50.)

Reviewed by RALPH C. DAVIS, *Professor of Business Organization, Ohio State University.*

The author states that the book is written for "the young engineer" who "is called upon early in his career to study various engineering projects." Its purpose is "to provide an understanding of the economics of engineering project analysis so that he can provide the economic part of the report." It is considered that in general the economic analysis consists of three separate yet definitely related analyses; the "economy analysis" which attempts to discover the worthwhileness of the project in terms of yield on investment, the "intangible analysis" which attempts to discover the worthwhileness in terms of those factors which are difficult to evaluate because the factors of human judgment enter largely into their evaluation, and the "financial analysis" that deals with the problem of providing funds with which to make the project possible. The author believes that "the first two are definitely within the scope of training and experience of the young engineer."

The scope of the problem is indicated in the introduction to the book. While the book does not deal with all phases of it, the student should be familiar with the principal phases of the "engineering process." "The whole process will include the following steps, which illustrate the main functions properly

belonging to the engineer today: (1) Research on the problem of satisfying the need, (2) Invention or adaptation of existing means and methods to perform the task efficiently, (3) Preliminary valuation of the project, (4) Financial planning of the project, (5) Organization of effort for co-operation, (6) Promotion of the project, (7) Design of the project, (8) Design and construction of plant and equipment, (9) Supervision of operation and production, (10) Sale and distribution of the product." (A quotation from J. T. Hoover in the January, 1935, issue of the Journal of Engineering Education.) "Management may be considered from this point of view as being the art and science of directing and co-ordinating efficiently all these functions." Many readers may object to the definition of management as inadequate, and to the implication, that the terms "engineering process" and "management" are synonomous, as incorrect. Many of the functions assigned to the "engineering process" obviously do not have their foundations in the applied physical sciences.

Part I, the Economy Analysis, is concerned principally with such questions as; What is the cost of setting up the project? What is the cost of operating the project? What income may be expected from the project? What is the return to the promoter from the project? Is the project worth while? "An economy analysis is a study of the factors of cost that pertain to a specific project in order to be able to determine whether or not it should be undertaken." Chapters 1, 2, 3 and 4 give a good elementary discussion of depreciation, valuation and appraisal. Chapter 5 deals with "First Cost Patterns." It takes up the tendency of installations, or their elements, to decrease in cost with increasing size or capacity. Chapter 6, "Estimating First Cost," uses the Purdue Housing Research Project cost breakdown to illustrate the point that "in the cost summary the quantities and rates are actual and in the estimate they are probable." Chapter 7, "Operating Cost," and Chapter 8, "Estimating Operating Cost," give an elementary discussion of product costs and cost estimating. Chapter 9 deals with "Operating Cost Patterns." "An operating cost pattern is a chart or diagram that shows how the operating cost varies with capacity." Chapter 10 discusses "Economic Return and Yield." Chapter 11, "Criteria For Making A Decision," takes up the use of the operating cost patterns, the break-even chart, and the profit and loss statement as aids in deciding whether or not to undertake the project. Chapter 12 explains the "In-Favor-Of Analysis." This is merely a tabulation of the various factors affecting the decision, with a listing of their values under headings for each project under consideration, and a further listing to show the balance in favor of a particular project for each factor.

Part II, "The Intangible Analysis," deals principally with such questions as; What factors in the project are intangible? What factors are subjective? What factors are irreducible? How can the above factors be evaluated? In one chapter of twelve pages, the author discusses the intangibles involved in handling such factors as the consumer, the financier, the government, workmanship, workmen, the community and morals and ethics.

Part III, "The Financial Analysis," includes three chapters; Chapter 14—"Financial Return and Yield," Chapter 15—"The Financial Analysis," and Chapter 16—"Intangible Analysis of Financial Structure." It deals principally with such questions as: What funds are needed? What funds are on hand? What are the sources of funds? What financial structure should be used? The material includes elementary discussions of balance sheets, profit and loss statements, corporate finance and certain related topics.

Part IV considers "Special Methods And Applications." In Chapter 17, "The Break-Even Chart," the properties of the break-even chart are discussed in relation to costs. In Chapter 16, "Economic Characteristics Of Power Generating and Power Using Equipment," some consideration is given to power costs. Chapter 19, "The Increment Cost Principle," discusses the effects on costs of incremental increases in load or capacity. Chapter 20, "The Problem Of Replacement," takes up various cost and financial problems having to do with the replacement of plant and equipment. In Chapter 21, the application of "The Endowment Principle" to the problem of funding operating and replacement costs is discussed. "Some Aspects Of Public Projects" are considered in Chapter 22. The book closes with Chapter 23, which gives a brief summary of economy studies and reports. There are two appendices dealing with "Compound Interest" and "Interest Tables."

The book is an elementary discussion of costs and cost estimating, with reference to various factors that affect investment and operating economy. The body of the book includes the Introduction and 23 chapters and covers 308 pages. The average chapter size is 13 pages. Most chapters have one or more pages of problems at the end. The scope of the book is too narrow to entitle it to be called a text on economic analysis. It is, rather, a book that deals with certain phases of cost and financial analysis. It contains little new material. However, the author states that it was written for the "young engineer." The book should aid him in getting an elementary understanding of the topics treated.

The Theory and Practice of Job Rating. By M. F. Stigers and E. G. Reed, McGraw-Hill Book Company, Inc., New York and London, 1942, pages ix, 154. ($1.75.)

Reviewed by EDWARD N. HAY, *Personnel Officer, The Pennsylvania Company, Philadelphia, Pennsylvania.*

Methods of wage and salary determination have come to occupy a high place in the minds of management. Their importance has been further sharpened by the increasing growth of unionism and by the tendency of organized labor to take an interest in all problems of industrial management which directly concern the worker. The current development of labor-management committees is a further spur toward better methods of evaluating wages and salaries. Some recent experience shows that the participation of labor in wage determination is a strong influence working toward better job evaluation methods.

Everyone interested in better methods of job evaluation will therefore welcome this little book by Stigers and Reed. It contains an original idea which consists in combining the principle of factor comparison[1] with a typical point method.[2]

The essence of the factor comparison method is that jobs are

[1] Benge, Eugene J., Burk, Samuel L. H., and Hay, Edward N., *Manual of Job Evaluation*, Harper & Brothers, New York, 1941.

[2] Kress, A. L., "How to Rate Jobs and Men," *Factory Management*, October, 1939.

evaluated by comparing them one with another, one factor at a time These factors are the elements common to all jobs, such as responsibility The point method employs a series of scales for a number of factors common to all jobs, each scale assigning point values to various degrees or levels of each factor. By comparing each scale with the job we may determine the point value for the job in regard to each factor. The sum of these points determines the job value in points, which may then be converted into wages or salaries.

Stigers and Reed combine these two methods in a simple but ingenious manner. The way this is done is described on page 39, in the chapter "Illustration of Basic Principles," and is further developed on page 114, in the chapter "Cross Comparison Procedure." With the typical point method the number of factors is predetermined and unvarying in number for all jobs. The range of variation, or "level" for each factor in points, likewise, is predetermined and fixed in advance. This seeming definiteness has the disadvantage of being inflexible and makes the point system adapted only to a situation in which most of the jobs are essentially alike. The transition from low-value to high-value jobs is difficult under the point method, because the elements that have been selected are not often common both to high-valued and low-valued jobs.

The factor comparison method overcomes these disadvantages. Its scales are open at both ends for extension to higher or lower levels. The factors used are broad and general, and applicable to *all* jobs. The factors usually used are mental requirements, skill requirements, physical requirements, responsibility and working conditions. The method outlined by Stigers and Reed combines the advantages of both systems. The factors are specific in nature and the valuation of jobs is determined essentially by the process of comparing one factor of a job with the same factor of another job, or jobs. Another principle is introduced for the first time, so far as I know, in that the various factors in each job are ranked from high to low in their importance. Furthermore, the method does not restrict itself to a fixed and definite set of factors: the number of factors used may be unlimited. No two jobs need have the same factors, although most of them would naturally be the same. Whenever a job turns up that has a factor not previously found in any other job, that factor may be added to the list and that job given credit for its presence. The ingenious scheme of cross comparison makes it possible to bring jobs into line with each other by comparing the values for each factor common to a given group of jobs.

This process of ranking factors from the least to the most important for each job, and of cross comparison of identical factors in different jobs, has the effect of gradually weaving a tight fabric of inter-relationships. The final result, as in the original factor-comparison method devised by Benge, is an accurate relationship of value between jobs. This is sometimes called "internal consistency."

The method of relating point values to wages is similar to that used by some others. However, when dealing with salaries there should be a definite progression of salaries in geometric ratio.[3] This technique is not touched upon and while the authors' method of relating points to money value is good enough for the narrow range of hourly wages, it is too crude for the wide spread found in salaried jobs. The geometric relationship may be easily shown in developing salary relationships by the use of semi-logarithmic cross-section paper.

The original contribution of this book is most important and greatly overshadows its defects in detail. The actual work described does not seem to represent an entirely practical and well-worked-out method. For example, there are far too many factors, or job elements, as they are called, and there is a good deal of overlapping. Some of these factors attain high values, whereas others are insignificant in value. For example, one job with a 498 total point value has 347 points divided among the three factors of strength, learning time and responsibility, with the remaining 151 points divided among 17 other factors, including one point for monotony, two for originality, two for memory, two for fumes, four for noise, four for body contact, four for application. In general, three or four factors cover 70 per cent to 85 per cent of the total points, with many other factors contributing insignificant amounts. For instance, ten jobs which include the factor of monotony received only 1 to 5 points credit each. It is clear that a smaller number of factors would be equally satisfactory, eliminating the ones which do not contribute much in the way of point value to any job. Experience shows that evaluation becomes very burdensome when there are more than five to eight factors.

An interesting contribution to job evaluation is the introduction of what is called "design." For example, if it is desired to encourage safety a study of those jobs which show a considerable number of points credit for safety can be made with the purpose of reducing the risk. When the changes have been made the number of points credited for safety would correspondingly be reduced, and the wage rate for the job would then be lower. Thus, an energetic campaign of decreasing hazards would result in reducing wage costs. In the same manner, the quality of work could be influenced by giving increased values for the factors which underlie quality of work.

Those who are accustomed to relying on a careful description of jobs as a basis of job valuations, will find lacking any emphasis on detailed and carefully prepared job descriptions. The authors are apparently unfamiliar with the phenomenon of individual differences, because they make the remarkable statement that "If the job is properly analyzed so that only the one best method is used, all the trained workers will produce very near (sic) the same maximum production, and a piece work incentive will not materially increase the output." Again they say, "In industrial work, it has been found that the time required to perform any given and exact motion is almost constant for all skilled operators." And "as a result, any normal man can usually be trained to meet the maximum requirements of any industrial job."

In spite of small defects, this book makes a contribution of great value to the literature dealing with wage and salary determination. The theoretical principles outlined will, if properly adapted, produce better results than by most methods now available.

[3] Hay, Edward N., "Constructing Salary Scales," *Personnel Journal*, April, 1936.